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FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

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The Red Flag . . .

THIS journal was among the first to direct attention to the challenge of Russian airliners. That was early in 1956, when it was fashionable to chortle over the Tu-104's *fin de siècle* interior and to hoot over its simply impossible economics. Since then the Tu-104 has grown up, and we can only hope that some of its critics have done likewise. Today the twin-jet Tupolev is in Aeroflot service, not as a 50-seater V.I.P. prestige and propaganda showpiece, but as a 100-seater workhorse, groomed as a world-challenger together with the newer An-10, An-16 and Il-18, and, of course, the gigantic Tu-114.

The theme of our admonitory remarks so long ago is now echoed in a report by the Canadian-American Committee (composed of the National Planning Association in the U.S.A. and the Private Planning Association of Canada). Having made the point that Russia's rate of economic growth is twice that of the U.S.A., the report goes on to suggest that with further development there is likely to be a growing potential for a Soviet "offensive" which could result in substantial changes in the pattern of international trade. Up to now, it is pointed out, Soviet production has been used to build an industrial base and a modern military system. However, the industrial base is now so large that Soviet management can divert substantial resources abroad "to foreign political ends" without seriously interfering with expansion. Given the demand in underdeveloped countries for air services and the increased Soviet capability to provide equipment, air transport is shaping up as a major economic and political battlefield. The report concludes: "The Soviets, with their flexibility of manœuvre, may be able to dominate the next stage in the development of air transport in underdeveloped countries."

. . . and the Red Light

The foregoing contentions will be widely accepted—more widely perhaps than the Committee's belief that the West "will have to provide from time to time the latest jet and turboprop aircraft or be prepared to see the Soviets move in with gifts or bargain sales of Ukrainas, Moskvas and other modern aircraft." For we cannot envisage parcels of Moskvas being handed out like sacks of rice. They and their contemporaries are intended as best-sellers, not as hand-outs.

It is curious that, although the world admits Soviet leadership in space exploration, there is reluctance, bordering on refusal, to recognize the qualities of Soviet aeroplanes. It is true that the Russians have been having "a Christian amount of trouble" with their new brood (we quote a comment of Sir George Edwards about one of his own aircraft). But it is equally true that the F.A.I. Bulletin lists world records by the Tu-104 and Il-18 airliners, the Mi-1, Mi-6 and Ka-15 helicopters, and mystery aircraft having the cryptic designations "T.431" and "RV." It is the T.431 which holds the altitude record of 94,659 ft; and last week came Russia's claim of a new world speed record, by an "E-66." This delta achieved 1,493 m.p.h.—a 90 m.p.h. advance on the mark set by a Lockheed F-104. And on the same day the Russians "threw away" two more records—42,650ft with over 54 tons by a "201-M," and 639 m.p.h. over 620 miles with 27 tons by a "103-M."

At this rate the Soviet Union will soon hold every major record, official and unofficial, aeronautical and astronautical. The red light is flashing.

FROM ALL QUARTERS

RUSSIAN CIGARETTE: Face-piece of partial-pressure helmet off, record-breaker Mosolov enjoys a smoke (picture by wire; news below)

Soviet Record Claims

THREE new world records have been claimed by the Soviet Union, for absolute speed, for lifting a load to height and for speed over a fixed course with specified payload. The absolute speed record is claimed for an E-66 piloted by Col. Georgy Mosolov, which on October 31 averaged 1,493 m.p.h. on two runs, on one of them reaching 1,566 m.p.h. This is the first mention of the designation E-66, which possibly refers to a Sukhoi delta-wing fighter. The present official world speed record, 1,403.15 m.p.h., was set up last year by Capt. W. Irwin of the U.S.A.F. in an F-104A.

The other records claimed by the Russians are for a 201-M which on October 29, carrying a crew of seven, reached a height of 13,000 m (about 42,651ft) carrying a payload of 55,220 kg (about 121,500 lb); and for a 103-M which on October 30 with a payload of 27 tons flew 1,000 km (about 620 miles) at an average speed of 1,028 km/hr (about 639 m.p.h.). These two designations are also new.

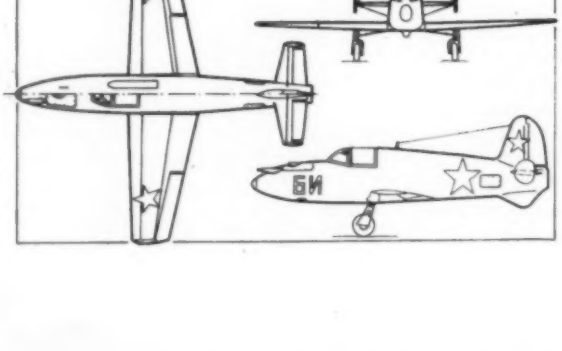
Details of the record claims are being sent to the International Aeronautical Federation.

Armament Research on Show

LAST week, and for the first time, the Armament Research and Development Establishment at Fort Halstead, Kent, held a series of open days. Local-government authorities, members of industry, the universities and technical colleges and foreign diplomatic representatives were invited to view a very large number of exhibits and demonstrations of the work of the establishment in developing guns, gun-mountings, fuzes, small arms, ammunition, mines and pyrotechnics for all three Services. A.R.D.E. has outstations at Woolwich, Langhurst, Potton Island and Enfield, the last-named responsible for the Aden gun ("Armament Design Enfield"). One of these was shown firing a 25-round burst on a 25 yd range. A.R.D.E. is also concerned with certain aspects of guided-weapon development, including such items as safety and arming mechanisms, fuzes and warheads. Excellent colour films were shown of Blue Sky (Fireflash) and Seaslug firings against Meteor and Firefly drones. Automatic loading and salvo firing from H.M.S. *Girdle Ness* were featured and Fireflashes were shown being launched from a converted Meteor NF.11.

Investigation of atomic blast effects on missile launchers, and research into molybdenum characteristics under extreme temperatures were explained; and the use of inertial components for certain guidance functions was illustrated by a trolley-mounted Kearfott feed-back accelerometer running on a rail. A large number of exhibits concerned fuzing, and demonstrations and films showed radio-proximity fuzes and their automated manufacture. Many types of test equipment for explosives and artillery trials were illustrated and one exhibit showed an infra-red light beam modulated by tape-recorded music and speech. Though this was properly used for timing shells, it formed the basis of a discreet communications link for ranges of several miles. A film showed radio-proximity fuzes in shells fired at aircraft silhouettes suspended from a test tower.

REACTIONARY RED: This is the first illustration to become available of the "BI," the first Soviet jet-propelled aircraft. Designed by V. F. Bolkhovitinova, it was powered by a bi-propellant rocket designed in 1939 by L. S. Dushkin. G. Ya. Bakhchivandji flew it on May 15, 1942



Ornithopters in the Family

A NEW manpowered ornithopter has been designed by Lawrence G. Watts, a technical artist in the Coventry office of Iliffe & Sons Ltd., publishers of *Flight*. This project represents the continuation of a family tradition in that Mr. Watts' grandfather, A. H. Watts, made a number of model and full-scale ornithopters between 1906 and 1920. A photograph of one of these is published for the first time below, and a later machine is claimed to have made a 150 yd flight in March 1920.

No details of Lawrence Watts' machine have been disclosed, apart from the fact that extensive use is made of plastics, but the design has been completed and it is hoped to begin construction soon. The designer is a power pilot, gliding instructor with Coventry Gliding Club, model maker and approved glider inspector and, although most of his work is carried out for our associate journal *The Motor Cycle*, he has been responsible for glider cutaway drawings in *Flight*.

Mr. Watts' grandfather became interested in manpowered flight in about 1900. He studied the flight of birds and insects, built a number of kites, and in 1906 began construction of his first man-carrying ornithopter. A failure, it was followed in 1911 by a second machine (illustrated below). The Patent specification stated: "The object of the present invention is to construct the machine in such a manner that it will rise from the ground and propel itself through the air very much after the fashion of a bird or insect. The wings may be operated directly by the aviator and for this purpose would be provided with inwardly directed shafts or handles. The manner in which the power is applied by the aviator . . . is somewhat similar to the operation of sculling, except that whereas in the latter case the direction of movement is approximately horizontal, in the present instance it is substantially vertical."

BIRDMAN'S CAGE: The first photograph to be published of a manpowered ornithopter built by A. H. Watts of Coventry in 1911. The bamboo framework was covered with paper fabric, and it is claimed that a subsequent Watts machine achieved successful manpowered flight. As reported here, Mr. Watts' grandson is following suit

This machine lacked sufficient thrust for take-off, although it is reported to have achieved a bouncing type of lifting motion in the back garden of Mr. Watts' Coventry home. His efforts towards manpowered flight were renewed after the First World

NEW YEAR MOVES at Brough: Mr. Arthur Jopling (left) who from January 1 next year becomes chairman of the Blackburn Group in succession to Mr. Eric Turner; and Mr. N. E. Rowe (centre) and Capt. E. D. G. Lewin, who from the same date become joint managing directors of Blackburn Aircraft Ltd.

X MARKS THE SPOT: Scott Crossfield had to make an emergency landing in a North American X-15 on November 5 when a fire warning light came on shortly after he had ported from the B-52. It is reported that he was uninjured, but—as seen here—the aircraft broke its back behind the cockpit during the landing

War and, after further model experiments, a third ornithopter was built in 1920. This was bat-like in design, with the pilot (who used his legs as the undercarriage) in a semi-prone position. Wing operation was by a system of levers projected to a point ahead of the pilot. It is claimed that this machine made a flight of about 150 yd in March 1920, following a running take-off from the brow of a bridge near Stoke, Coventry.

D.H. Propellers Changes

A REORGANIZATION has been carried out in the engineering division of de Havilland Propellers Ltd. Mr. G. C. I. Gardiner has been appointed chief executive of ballistic missile engineering, relinquishing his position as chief engineer but remaining technical director of the company; and three new chief engineers have been appointed. Mr. T. W. Air is now chief engineer of ballistic missiles, responsible for the technical aspects of this work; Mr. G. H. F. Brown, chief engineer (propellers, aircraft and industrial equipment), in charge of engineering activities other than weapons; and Dr. G. H. Hough, chief engineer (air-to-air guided weapons) with full technical and administrative responsibility for the company's design and development programmes for air-to-air missiles. In addition, Mr. C. C. Williams has been appointed general manager of the company's ballistic missile organization in its various locations. This new arrangement groups the company's activities into separate product divisions, each under its own engineering leader responsible to the managing director.

E.T.P.S. AT H.P.: Staff and students of the Empire Test Pilots' School visited Handley Page recently to see Victor production and the company's test facilities. They heard Mr. G. H. Lee, deputy chief designer, talk on the design of long-range supersonic aircraft; and (as seen here) were addressed after lunch by Mr. C. F. Joy, chief designer

Mr. Gardiner, who joined de Havilland in 1936, has been responsible for technical leadership of work on Firestreak since its inception in 1951. Mr. Air was for fifteen years chief engineer of the Commonwealth Aircraft Corporation in Melbourne and joined D.H. in Australia; Mr. Brown and Dr. Hough were original members of the Firestreak team; and Mr. Williams has been engineering and general manager since 1956.

Derby Tops the List

FIGURES given recently by the S.B.A.C. show that Rolls-Royce Ltd. are supplying twice as many engines for the international airliner market as any other aero-engine manufacturer in the world, and in fact more than all their competitors put together. Of the 1,454 pure-jet and turboprop airliners—excluding the Soviet bloc—on order or in service, no fewer than 56 per cent (817) have, or will have, Rolls-Royce engines. Their nearest rival is Pratt and Whitney, whose share is 21 per cent (304 aircraft). The remaining 23 per cent (333) is divided between Bristol-Siddeley, Allison and General Electric.

IN BRIEF

Mr. Duncan Sandys paid his first visit to the Bristol Aircraft Ltd. factories as Minister of Aviation when he lunched with the directors at Filton last Friday and afterwards saw something of the work on which the company is engaged. It was announced last week that Mr. Sandys has appointed Mr. Richard Hornby, M.P. for Tonbridge, as his Parliamentary private secretary.

The first two of a batch of 50 Dornier 27s ordered by the Spanish government are nearing completion at the Seville factory of Casa.

A memorial service for the late Mr. J. A. Mollison will be held at Christ Church, Down Street, London, W.1, at 12 noon on Wednesday, November 25.

The former Hawker Aircraft factory at Sutton Lane, Langley, Bucks, has been acquired by the Ford Motor Co. Ltd. who have been renting a large part of it since 1948.

Mr. A. J. Wallis, public relations officer for the Hawker Siddeley Group, has been appointed Editor of *Hawker Siddeley Review*. The task of preparing that well-known quarterly has been assigned to Mr. Derek G. T. Harvey, until recently public relations officer of Air Service Training, one of the companies within the Group.

Canadian Pratt and Whitney have concluded arrangements with Sikorsky Aircraft to produce a substantial number of turbine-powered HR3S-1 helicopters in Canada for Canadian military orders. The HR3S-1 is an adaptation of the HSS-2, now in production for the U.S. Navy. Canadian Pratt and Whitney and Sikorsky are associates in United Aircraft Corporation.

Two U.S.A.F. pilots from Edwards A.F.B. have been flying the Mirage III at Brétigny, testing take-off and landing runs, turn radius, stability during gun-firing and acceleration between M 1 and 2. One of them also flew the Communauté. A second Morane Epervier flew at Villacoublay on October 23 and is fitted with two 20 mm guns. The first prototype is at Brétigny.

There is a strong possibility that Holland and Belgium will follow Germany and Canada in ordering the Lockheed F-104G, in which case Fokker and Sabca would make the aircraft under licence. Canadian F-104s to be built by Canadair are designated CF-111, and the first is to be delivered early in 1961. Engines will be made by Orenda. Canadair will also deliver to Lockheed during next year 80 sets of wings, tail-surfaces and rear fuselages. The 200 complete CF-111 airframes are to cost $91.5m and the engines not more than $80m.

The chief photographers of B.E.A. and Vickers-Armstrongs (Aircraft) Ltd., respectively Mr. Harry Stewart and Mr. Leslie Sansom, adjudicated and presented prizes at the London Society of Air-Britain annual photographic contest at Caxton Hall on November 4. There were separate classes for black-and-white and colour entries, each sub-divided into static, flying and speed classes. A photographic prize donated by *Flight* was awarded to Mr. J. M. Corbell for winning Class 1 of the colour category with a study of the entrance to Blackbushe Airport; and first prizes in the other classes were won by Messrs. M. M. Gates, K. J. A. Brookes, R. Watt, J. M. Gradidge and B. Hank.

NEW POSTS under the de Havilland Propellers reorganization scheme referred to above are filled by (left to right) Messrs. Gardiner, Air, Brown, Dr. Hough and Mr. Williams

FLIGHT SYSTEM SURVEY

THIS is the first presentation of a new regular "Flight" feature intended to provide comprehensive coverage of developments in airborne and ground-based electronics and equipment concerned with navigation, traffic control and flight control, and, indeed, all systems which, centred on the flight deck, assist crews in piloting their aircraft. The great importance of such equipment in modern aircraft has already been specially recognized by "Flight" in the three annual special issues under the title "Flying Aids" (April 12, 1957; May 16, 1958; and February 20, 1959), and the more recent "Aviation Electronics" special issue of October 9.

Navigation Prospects

EVERY navigation aid now used in civil aircraft has shortcomings, whether they be in method of operation, range, accuracy, complexity or cost. Nor is there any certain prospect that any one aid will ever prove universally suitable. It is therefore reasonable to suppose that in something over ten years every airliner will carry at least three separate aids, one of which would probably be self-contained, another a co-operative ground-air system used strictly for navigation and a third based on a communication system evolved from present concepts of data links, secondary radar and related equipment.

The key to successful combined operation of all three systems would be a computer to assess the reliability and accuracy of the three position-signals and so derive a likely assessment of position. The final element would be a computer which would accept the positional information in its various forms and convert it to a rectangular-grid presentation on a pictorial indicator. Air data and attitude sensing would be centralized in the aircraft and appropriate information from these sources would be used in the navigation equipment.

At present, the most difficult problem is the production of a computer to convert hyperbolic navaid information for presentation in rectangular co-ordinates, the main difficulty being to devise a mathematical formula, or logic, capable of being applied in the computer. It can be assumed that Decca, who are closely concerned with hyperbolic aids, are working towards the solution of this problem and will sooner or later succeed.

Nevertheless, it seems probable that most of the aids now in use will be superseded by new systems at present only in the initial-study stage. Radio-signal propagation, extremely accurate frequency standards, satellites as artificial stars; these and other methods have yet to be exploited. Advanced computers, suitable for airborne use and capable of performing probability determinations and complex calculations, will certainly emerge.

The key to the simultaneous use of several aids in combination with advanced computers will be miniaturization. At the present rate of progress it is reasonable to assume that the weight penalty of using three advanced navigation systems and associated computers can be reduced to a level where it will become economic to carry the navigation package in even medium-range airliners.

As a consequence, I.C.A.O. standardization may be applied to three or more navigation aids, the majority requiring no implementation on the ground. Each would produce information in a standard form, and an international computer specification might be evolved. I.C.A.O.'s Annexe 10 might come to cover equipment at present far removed from the navigation field. The new equipment would certainly require fundamental reorganization of present manufacturing facilities and might give a distinct lead to those companies which can at an early stage build up the necessary knowledge of new factory processes. Now, more than ever, technological research is important because new methods will become a fundamental requirement for the production of new equipment.

Marconi S.264A and microwave aerials at Wellington (see col. 2)

Marconi S.264A Radars in New Zealand

SUPPLIED by Marconi, a 500 kW 50 cm surveillance radar, type S.264A, is now operating on a 1,630ft-high ridge near the newly opened Wellington airport in New Zealand. Another S.264A is being installed at Ohakea. For the Wellington radar, the 52ft 6in-long, 7.5 ton head is designed to turn at full speed in 60 kt winds, at half speed in 90 kt winds and to withstand 120 kt winds. The building supporting the radar head and containing the duplicated transmitter/receiver has a 15in-thick reinforced concrete roof and a minimum wall thickness of 9in.

The equipment is remotely controlled over a microwave link from the airways control centre four miles away; and radar signals are passed on this and another microwave link respectively to two Marconi fixed-coil displays at the airport and four similar displays at the control centre. Microwave links were used because of the great cost of co-axial land-lines and the risk of cable fracture during seismic disturbances which may occur in the area. Video map equipment is also provided at the control centre. Marconi fully coherent M.T.I. ensures cancellation of clutter from surrounding mountains and from rainstorms. The value of the contracts for the Wellington and Ohakea radars is stated to be £300,000.

Cockpit indicators and push-button target selector for P.H.I. Mk 3 (see news-item below)

Fighter Navigation Developments

CONSIDERABLE information has now become available on the navigation equipment to be fitted in Fiat G.91s and Lockheed F-104Gs to be used by European and Canadian air forces. Present Italian air force G.91s are to be fitted with the Computing Devices of Canada's Position and Homing Indicator which is an analogue vector computer using air data sensed in the aircraft. An initial order for $1,600,000 has been placed through Bendix Aviation Corp. for P.H.I.s for German F-104s.

Vector information is provided to one of five destinations or targets set as precision potentiometer adjustments in a miniature package issued to a pilot before take-off and plugged by him to a receptacle on the starboard console. The take-off point or base is set as a zero value for x and y co-ordinates and a continuous plot is kept to provide constant bearing and distance information on a single dial. Tacan or equivalent bearings may be added to correct for inaccuracies in the manual wind-setting, and any one of four alternative points can be selected for steering and distance information on the miniature push-button package. Twelve or more destinations may be allowed for, or additional packages may be carried and inserted in flight.

A vector adder unit may be added to P.H.I. to allow the setting of a new target destination following voice instructions from the ground. Inaccuracies caused by time-lag in transmission of instructions can be avoided by use of a data link. Conversely, an automatic interception director can allow a G.C.I. station to supply a moving target vector so that the aircraft may follow a pursuit curve to an interception. If an interception computer is available on the ground, the new target may be set as a collision point to allow collision-course interception. Check fixes from Tacan can be set into the P.H.I. as a correction so that a new average value for wind velocity is established. Meteorological

Aerial structure of the Decca Radar early-warning-type radar produced under M.o.S. contract for the R.A.F. Largely of aluminium, it is mounted on a turning gear produced by John Curran Ltd. Royal Radar Establishment and J. Starkie Gardner Ltd. co-operated in designing radar and aerial respectively. The reflector, certainly over 50ft in span, provides cosec² scan over a very narrow beam and has linear waveguide feed. The system is said to be able to "pinpoint swift-moving targets far out from the coast, giving adequate time to alert defences"

data supplied before take-off is estimated to allow only five per cent accuracy.

Doppler radar signals, which P.H.I. can accept, can make dead reckoning the accurate basic method of navigation; and, if such signals are maintained for 65 per cent of the flight time, then the limiting factor in accuracy is the directional reference. Loss of Doppler signal during pronounced attitudes and over smooth sea can be an important factor in fighter operations.

Fiat G.91s for the German, Turkish and Greek air forces will carry the P.H.I. 3B together with the Bendix DRA-12 Doppler, with its aerial mounted in the 1.5in-deep space beneath the air intake. In this system, P.H.I. will still calculate from air data with Doppler corrections, but it will also make continuous computations of wind vector so that this factor can be superimposed on running calculations and after loss of Doppler signal.

By recording Doppler corrections during a programmed climb, a fighter can be used as a meteorological sonde to assess weather conditions before an ICBM launch. If radiation is a tactical problem, the Doppler may be set to transmit for a few seconds at intervals.

The first installation of the P.H.I. 3B in a German Fiat G.91 is complete and flight trials are to begin at Pratica di Mare, near Rome, in January. The Italians have intimated that NATO representatives will be welcome to observe the trials. The Swiss Air Force has carried out trials at Zurich and a P.H.I. has been tested in a French Air Force Meteor. A P.H.I. 3B has been delivered to France for trials in a Canberra in the near future and later trials will be made in a Dassault Etendard IVM and a Mirage IIIC. Trials in Japan will begin in January.

An inertial sensor based on a platform, made by Litton Industries and costing £35,000 each, is to be combined with P.H.I. in both German and Canadian Lockheed F-104Gs. Although Litton make the almost startling claim that their platform can ensure a position accuracy of ±2 miles after a one-hour flight, both the German and Canadian systems will maintain a position memory based on air data, using inertial signals to supply a wind correction. It has still not been established how reliable the platform will prove nor for how long it can remain reasonably accurate before cumulative errors, which multiply as the square of elapsed time because of the double integration, render computations useless. Present estimates put the maximum time as about one hour. For German F-104 operations the effect of wind is reckoned to be very small, giving drift errors less than seven per cent in any wind in which the aircraft may be operated. The Canadian requirement, however, envisages a return to base down a specified corridor free from anti-aircraft defences and only four miles wide. Normal drift-correction operation of P.H.I. cannot clearly delineate this limit, but the location of a number of the available reference points along the corridor would make any track errors more readily appreciated.

German F-104Gs would be equipped with a Mergenthaler Lynotype Corp. bombing sight (Saab licence toss-bombing computer), but Canadian aircraft would have a General Electric computer requiring range wind, drift angle and change-of-height data to be supplied from the P.H.I. unit. The P.H.I. would also supply signals to the autopilot and this would be automatically disengaged whenever the selected destination was altered or when the aircraft came within ten miles of the selected target. For reconnaissance purposes the P.H.I. could supply position, height and speed signals to be automatically superimposed on each picture frame.

Decca Navigator in Italy

A MOBILE, two-pattern Decca Navigator chain has been set up to cover central Italy for NATO evaluation of its use in lightweight strike/reconnaissance fighters. A Fiat G.91 has been fitted with Decca for this purpose. The Italian air traffic control authorities, still mainly a military organization, last month witnessed two programmed trial flights by Decca's Valetta between Rome/Ciampino and Elba. Complex tracks were flown with a Flight Log to show the capabilities of Decca and particularly the ability to fly very accurate tracks in dual-track airways, hold at arbitrary points, follow curved tracks and calibrate N.D.B.s and V.O.R.s.

Rome is a busy terminal area, but is ringed with danger areas and not well served with navaids. There is still no autonomous civil aviation directorate, the function of such a body being performed by the air ministry. Further Decca trials with the Valetta are to be held near Rome soon.

Back-to-back aerial system for Hydra, another Decca Radar military radar. Twin-horn feed to each reflector (only single horns are here shown) produce a pattern of four beams on 10 cm wavelength and "remarkable performance and versatility." Blanking on the inner ranges of the lower of each pair of beams is used to suppress clutter (air target indication). The aerial was designed in co-operation with Société Nouvelle d'Electronique. Hydra incorporates comprehensive anti-jamming devices and meets recognized military specifications for long-range air defence

One of the projectors for the Thorn visual glide-path indicator

Thorn Produce V.G.P.I.

THE visual glide-path indicator system developed by B.L.E.U. and first described in *Flight* for August 15, 1958, is now being manufactured under licence from the N.R.D.C. by the components and connector division of Thorn Electrical Industries Ltd., Great Cambridge Road, Enfield, Middx. One system has been working at the touch-down end of Runway 28L at London Airport since June for M.T.C.A. (and now Ministry of Aviation) evaluation (*Flight*, September 11) and another system has been ordered for earliest possible delivery to the American F.A.A. experimental centre at Atlantic City. Illustrated above is one of the four indicators employed in each system.

Missiles and Spaceflight

DISCOVERER 7

The Discoverer series of satellite launchings suffered a further setback on Saturday, November 7, when the seventh satellite in the series developed instability in orbit and also failed to eject its re-entry capsule. The satellite was launched from Vandenberg A.F.B. by a Thor-Hustler into an orbit having an initial perigee of 104 miles and apogee of 550 miles. The instrument capsule weighed 310 lb and was scheduled to be ejected on the 17th revolution. A U.S.A.F. spokesman later said that there seemed to have been a power failure in a part of the electrical supply system designed to separate the capsule from the satellite and to place the satellite in the correct position for capsule ejection.

NOBODY'S BABY

The photograph on the right is the first to be released showing a static firing of the E-1 rocket engine developed for the U.S. Air Force by the Rocketdyne Division of North American Aviation. Rated at 400,000 lb at sea level, the E-1 is reported to have been fired some 50 times and to be demonstrating a high degree of reliability. According to the manufacturer, it is "contributing information on combustion, turbomachinery design and systems operation for very high thrust engines." Yet, notwithstanding America's pressing need for such units, it has no announced application.

VEGA DETAILS

New information on the U.S. Vega space vehicle was disclosed last month by the NASA Jet Propulsion Laboratory of California Institute of Technology. The basic Vega vehicle comprises an Atlas first stage modified to accommodate large upper stages; a second stage consisting of propellant tanks and a modified G.E. engine; and, for deep space probes or high-altitude satellites, a third-stage JPL engine.

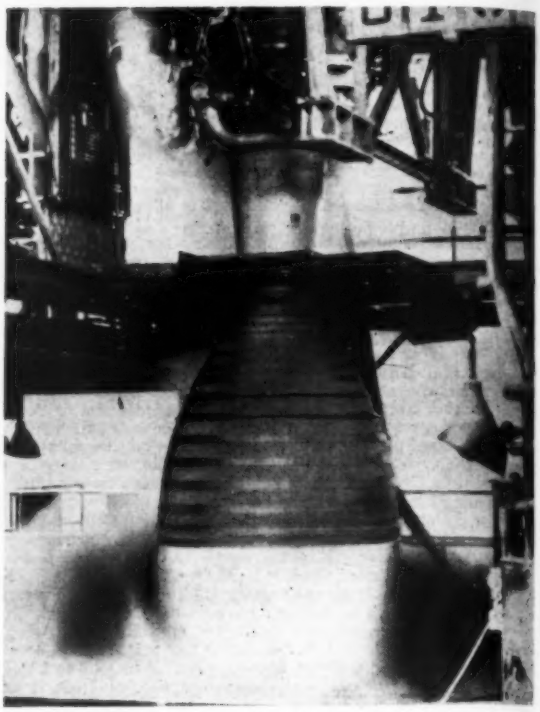
"Vega will be the first three-stage, liquid-fuelled, fully-guided vehicle developed in this country," a JPL spokesman said. "The second-stage General Electric 405H-2 engine has the capacity to be restarted after it is stopped. The third-stage engine is a storable liquid using nitrogen tetroxide as the oxidizer and hydrazine as the fuel.

"The fuel and oxidizer are pumped into the combustion chamber by a simple cold helium pressurization system. This is the first practical application of nitrogen tetroxide and hydrazine in a propellant system. It is a combination which offers the highest performance, together with a high degree of reliability, of those available for storable systems. Thrust is 6,000 lb."

SCIENCE ACCORDING TO LORD HAILSHAM

Speaking at a press conference on October 21 of his new responsibilities as Minister for Science, Lord Hailsham (Lord Privy Seal) averred that he was not Master of the Queen's Rockets and would not therefore play a decisive part in the politics of guided missiles. "You must not expect clutches of satellites to be flung into orbit in a miraculously short space of time," he emphasized. "The Minister is not a repository of brilliant new thoughts which have failed to appeal to anyone else. He is not an overlord to the Minister of Education and will not therefore be able to create vast new academies of science and technology."

The two-stage solid-propellant vehicle below—or one like it—passed within four miles of the NASA Explorer 6 satellite on October 13 while the latter was orbiting at 26,000 m.p.h. at 160 miles altitude. Related to the Bold Orion produced for the WS-199 programme for an air-launched ballistic missile (precursor of WS-138A), the vehicle is by The Martin Company. Infra-red windows may be seen in the second stage of the vehicle, which is slung from a GAM-63 pylon on a B-47 aircraft. The launching was at some 45 deg elevation at 35,000ft over Cape Canaveral



Static firing of a Rocketdyne E-1 (see "Nobody's Baby")

Last Sunday, November 8, the first consignment of Honest John artillery rockets for the Greek Army arrived in Athens.

On November 5—Guy Fawkes' day in the U.K.—the U.S. Air Force successfully fired an Atlas, a Jupiter and a Thor from Cape Canaveral. All three achieved their full design distance down the Atlantic missile range.

The competition between the Boeing and Martin teams for the U.S.A.F. Dyna-Soar boost-glide vehicle contract ended last Monday with a compromise award to both companies. It is reported that £19 million has been allocated to this project for the year ending next June.

According to a paper by Soviet scientists E. K. Fedorov and A. A. Blagonravov, quoted in *Missiles and Rockets*, a Russian two-man satellite will orbit the Earth for 14 days by the end of this year. This will be followed by a two-man flight around the Moon and, in March or April next year, a flight around the Moon (lasting six months) by two men and two women.

Speaking in Idaho on November 3, Maj-Gen. David Wade, Commander of the First Missile Division of U.S.A.F. Strategic Air Command, said that at Vandenberg A.F.B. a complete Atlas Squadron was "ready to go into operation on 15 min notice." The squadron is undoubtedly the 567th, who achieved the first Air Force firing of an ICBM on August 31.

Following the decision of the U.S. Department of Defense to cancel the fifth (reserve) squadron of Thor IRBMs, it appears that the total operational deployment of such missiles will be: SM-75 Thor, four squadrons (60 missiles on launchers), all based in England with R.A.F. Bomber Command; SM-78 Jupiter, one squadron (15 missiles) in N. Italy with U.S.A.F. Strategic Air Command or Southern Army Group and one squadron in Turkey (U.S.A.F. initially, later Turkish).

In last week's issue we published a provisional drawing of the Minuteman ICBM which is under development for the U.S. Air Force. This was based on an estimated length of 55ft; it is now learned unofficially that Minuteman will, in fact, be rather longer. One authority suggests a length of 65ft. This is the same as the Thor IRBM, but the latter has much greater bulk. Although Thor is representative of the best which could be achieved during 1956, a comparison between it and the new Minuteman emphasizes the great advances recently made in solid-propellant propulsion, warhead weight and airframe design. Moreover, the Minuteman guidance system is likely to weigh barely half the 500 lb of the AChiever system used in Thor.

Missiles and Spaceflight . . .

AROUND THE MOON

THE Soviet space probe Lunik 3, and its equipment, were given what was probably the fullest official descriptive publicity of any Russian space achievement to date. Included in an article "The Third Soviet Cosmic Rocket" published in "Pravda" last month was an account of the factors involved in calculating and achieving the probe's precise orbit, and this is reproduced, slightly condensed, on this page.

THE orbit of the automatic interplanetary station has been adapted specially to the solution of the set of scientific problems with which it was faced. In order to obtain the desired orbit—in addition to ensuring the necessary speed and direction of the station's flight at the moment the motor of the rocket's last stage was switched off—the gravitational pull of the Moon was also utilized.

The trajectory of flight around the Moon had to satisfy a number of requirements. In order to ensure the correct functioning of the orientation system at the time of photographing the Moon, it was necessary that the Moon, the station and the Sun should lie approximately in a straight line at the initial moment of orientation. The distance between the station and the Moon during the photography period was chosen in the 60,000 to 70,000 km range.

The character of the trajectory had to make possible the acquisition of the maximum quantity of information on the first curve around the Moon, and especially at small distances from the surface of the Earth. With a view to meeting this requirement it was necessary to ensure optimum conditions of radio communications with the interplanetary station from points lying in U.S.S.R. territory. For the purpose of scientific research it was also highly desirable to obtain a trajectory that would ensure the flight of the interplanetary station in space for a sufficiently long period of time.

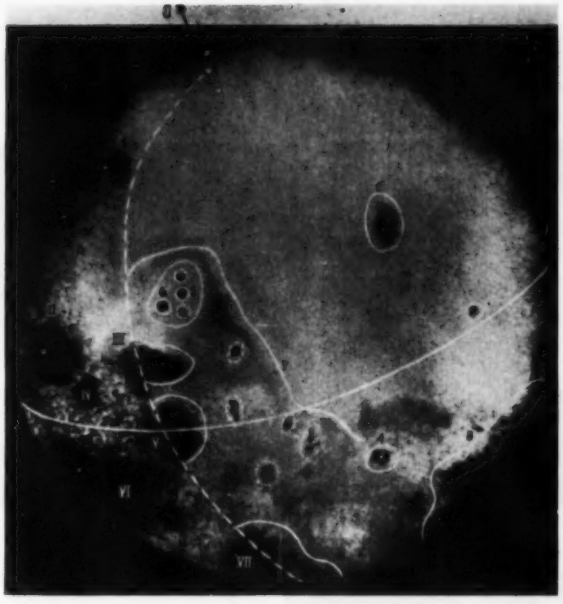
A flight around the Moon with return towards the Earth can be carried out along various types of orbits. In order to achieve such orbits the speed at the end of powered flight must be a little less than the so-called second cosmic or parabolic speed, which is equal, near the surface of the Earth, to 11.2 km/sec. If the orbit of the flight is several scores of thousands of kilometres from the Moon, its influence is comparatively small and the flight, in relation to the Earth, will take place along an orbit approximating an ellipse with one of its foci at the centre of the Earth.

However, the orbit of a distant flight around the Moon circling it at a distance of several scores of thousands of kilometres, has a number of basic drawbacks. By circling the Moon at a great distance it is impossible directly to explore cosmic space in the immediate vicinity of the Moon. When the rocket is launched from the northern hemisphere, the return towards the Earth takes place from the side of the southern hemisphere; this complicates observations and reception of scientific information by stations situated in the northern hemisphere. The flight near the Earth, on the return trip, takes place outside the limits of visibility from the northern hemisphere, and therefore the reception of information near the Earth of the results of scientific observation becomes impossible. On its return towards the Earth the rocket enters the dense layers of the atmosphere and burns up—i.e. the flight ends after the first loop.

These drawbacks can be avoided by making use for the flight around the Moon of another type of orbit, passing the Moon at a distance of several thousands of kilometres. The orbit of the automatic interplanetary station passed the centre of the Moon at a distance of 7,900 km and was calculated in such a manner that when the station was at its nearest point to the Moon it was to the south of it. As a result of the Moon's gravity, the orbit of the automatic station was deflected, in accordance with calculations, to the north. This deflection was quite considerable and the return towards the Earth was taking place from the northern hemisphere . . .

The greatest distance of the station from the Earth amounted to 480,000 km. Thus, in flying near the Moon, it is possible to achieve trajectories of the movement of the automatic interplanetary station which are exceptionally interesting and advantageous from the point of view of scientific research and of receiving scientific information. The flight of the interplanetary station near the Earth then takes place at such great distances from its surface that the drag over the atmospheric resistance does not exist. Thus, had the movement taken place only under the influence of the Earth's gravity, the automatic station would be an Earth satellite with an unlimited life period. In fact, however, the time of the station's flight is limited. As a result of the perturbing influence of the Sun's gravity, the smallest distance of its orbit from the Earth—the height of its perigee—is gradually diminishing. Therefore, having made a certain number of circuits, the station will enter dense layers of the atmosphere and burn up . . .

The influence of the Moon is not limited to the effect produced during the period of the first close approach. The perturbation of the station's orbit by the Moon's gravity is not of such a regular nature as the perturbation created by the Sun, and depends to a great extent on the period of circling the Earth. The Moon's influence can be considerable only when the station makes a sufficiently close approach to the Moon on one of the subsequent circuits. In this case the station will be nearest to the Moon roughly at the same point of the orbit as the first time.



The first picture of the far side of the Moon, obtained by Lunik 3 and published in Moscow on October 27.

Names of the main features, bestowed by a special commission of the Soviet Academy of Sciences, are: (1) Moscow Sea; (2) Astronauts Bay; (3) continuation of Southern Sea; (4) crater of main Tsiolkovsky Hill; (5) crater of central Lomonosov Hill; (6) Joliot-Curie crater; (7) Sovietsky mountain range; (8) Dream Sea. The dotted line indicates the boundary of the hemisphere seen from the Earth, previously identified features to the left of which are: (I) Humboldt Sea; (II) Sea of Crisis; (III) Regional Sea; (IV) Sea of Waves; (V) Smith Sea; (VI) Sea of Fertility; and (VII) Southern Sea.

In the case of repeated close approach the nature of the station's movement could change substantially. If the interplanetary station were to pass the Moon from the south—that is, if the second approach were of the same type as the first, the number of revolutions and the period of the station's life, preserving the main features of its trajectory in approaching the Earth from the northern hemisphere, would sharply increase. If the repeated passages were to take place from the north, the height of the orbit's perigee would be diminished, and in the case of a sufficiently strong perturbation a collision with the Earth could occur during the next return trip to it.

Along those loops of the orbit where there is no close approach to the Moon, the latter nevertheless has some influence on the station's movement. Although the force of the Moon's gravity in this case is very small, the Moon's gravity, by acting on a large number of loops of the trajectory, nevertheless has a noticeable influence on the movement of the automatic station, causing a reduction in the height of the perigee and in the period of the station's existence in orbit.

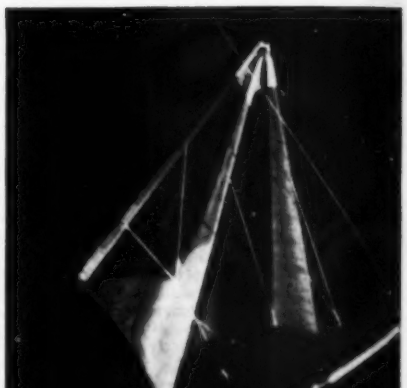
The picture of the movement of the automatic interplanetary station under the influence of the simultaneous forces of gravity of the Earth, Moon and Sun is very complicated. The nature of the first close approach to the Moon is decisive for the further movement of the interplanetary station. As no corrections in the station's movement are made during its flight—its whole flight being determined in the final analysis by the parameter of the movement at the end of powered flight, notably by the magnitude and direction of speed—it is clear that the realization of the above-mentioned trajectory by the space station is possible only by an exceptionally perfect system of control over the carrier-rocket during powered flight.

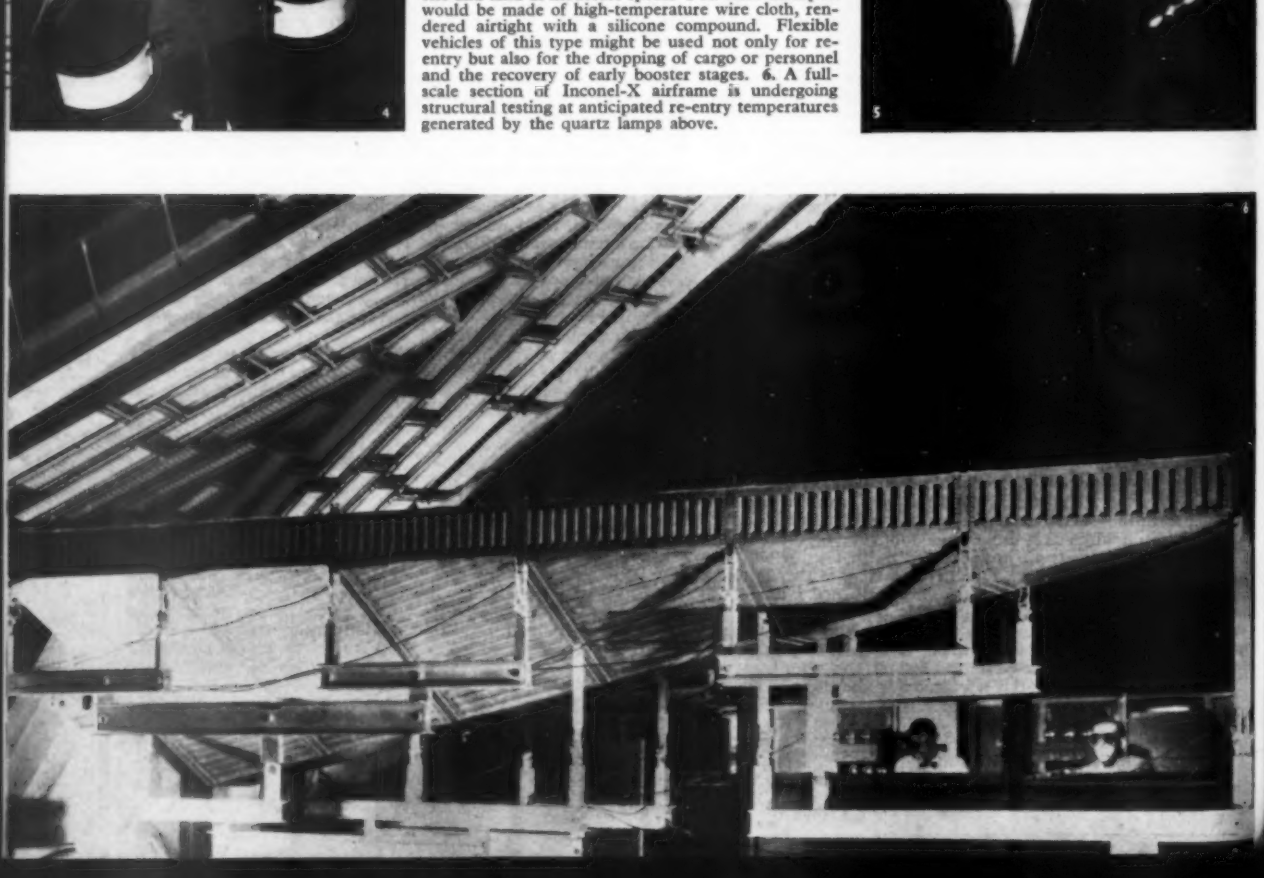
Calculations show that a deviation of the point of intersection of the station with the "picture" plane of 1,000 km will alter the minimum distance between the Earth and the station on its return by 5,000 to 10,000 km, and the time of its nearest approach to the Earth by 10 to 14 hours. This "picture" plane in this case is the plane lying through the centre of the Moon perpendicular to the line Earth-Moon.

Missiles and Spaceflight . . .

HYPERSONIC GLIDERS

POSSIBLY no type of vehicle poses such difficult design problems as does the true spacecraft, able to re-enter the Earth's atmosphere under full control and land more or less like an aeroplane. Extensive research on this type of craft is now in hand in many countries, and nowhere is it more advanced than at the Langley Research Center of NASA, where these photographs were taken. **1.** Free-flight testing of a high-drag re-entry vehicle, with flaps for manœuvre about all three axes and a recovery parachute. **2.** Free-flight testing of a half-cone body with flat delta wing for glide landings. **3.** This configuration is intended to re-enter at almost 90 deg angle of attack, with the wing tips folded vertically; the latter would extend (as illustrated) for glide landings. **4.** This glider would be launched as a tube, the wing and tail folding out to provide control upon re-entry. **5.** Good results have been achieved with this configuration, which is ejected from a tubular container by inflating the tube-like structures along each leading edge. Such a craft would have low acceleration and temperature during re-entry; and promises to be able to glide to a chosen site and land at moderate speed. Full-scale examples would be made of high-temperature wire cloth, rendered airtight with a silicone compound. Flexible vehicles of this type might be used not only for re-entry but also for the dropping of cargo or personnel and the recovery of early booster stages. **6.** A full-scale section of Inconel-X airframe is undergoing structural testing at anticipated re-entry temperatures generated by the quartz lamps above.





EXPLORER 4 AND THE VAN ALLEN BELT

AT the time when astronautical attention was focussed on the spectacular achievement of Lunik 3, a significant U.S. satellite re-entered the Earth's atmosphere and was presumably burnt up. The satellite, which had completed some 6,400 revolutions, was Explorer 4, and the date was believed to be October 23. In this article we review Explorer 4's background and the important radiation knowledge which it gained.

No account of Explorer 4 would be complete without mention of Explorers 1 and 3. These satellites were designed, amongst other things, to measure cosmic ray intensities between heights of 100 and 1,700 miles above the Earth's surface. Analysis of the telemetry data from these satellites showed that up to a height of 400 miles the intensity of radiation was in close agreement with that expected. Above about 600 miles, however, the intensity increased rapidly with distance from the Earth—at times, in fact, the counters ceased to register, because they were incapable of dealing with such high intensities. This sudden increase in intensity was completely contrary to expectations, and it was evident that radiation was in some way restrained from the lower altitudes. Prof. James Van Allen of the State University of Iowa suggested that the restraining influence must be the Earth's magnetic field, and hence the radiation must consist of charged particles.

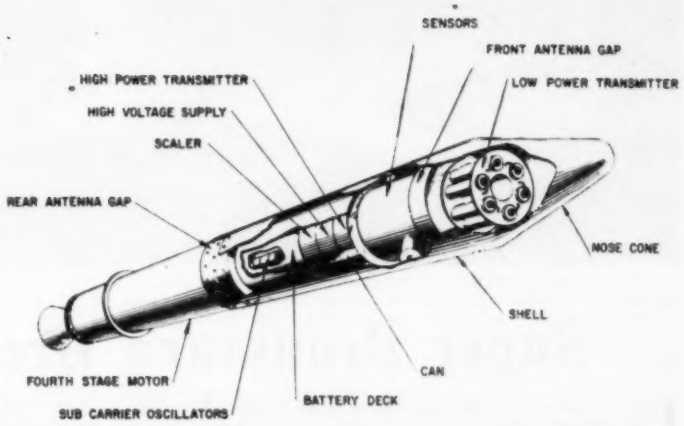


Fig. 1, Explorer 4, showing location of radio equipment. Launched on July 26, 1958, the 38.4 lb satellite was 80.39in long and 6.25in in diameter. Reported expiry date was October 23, 1959, after completion of some 6,400 revolutions

With this in mind, Van Allen and his associates specifically designed the instrumentation of Explorer 4 to further investigate the nature and distribution of the high-intensity radiation. Unlike Explorers 1 and 3, all the instruments carried were for the furtherance of radiation studies.

The instruments consisted of two Anton Type 302 Geiger counters (one completely unshielded and capable of measuring 1,500 times the capacity of the counters fitted to the earlier Explorers, and the other shielded by one-sixteenth of an inch of lead), and two scintillation counters to measure the energy of the radiation. Two radio transmitters were carried: a low-powered transmitter of 10 mW working on 108 Mc/s, and a high-powered transmitter of 30 mW using 108.03 Mc/s. Mallory mercury batteries provided the electrical power. Total weight of the counters, transmitters and batteries was 18.26 lb, nearly 8 lb heavier than Explorer 3. Gross weight of the satellite was 38.4 lb and, like earlier Explorers, its shape was cylindrical, 80.39in long and 6.25in in diameter.

Explorer 4 was launched in a north-easterly direction from Cape Canaveral by a modified four-stage Jupiter C vehicle at 2.59 p.m. G.M.T. on July 26, 1958. The initial orbit had a perigee height of 163 miles, an apogee height of 1,380 miles and a period of 110.27 min. Inclination of the orbital plane to the equator was 50.3 deg, approximately 17 deg greater than Explorers 1 and 3.

Both transmitters worked satisfactorily until September 3, 1958, when the low-powered transmitter failed. The high-powered transmitter continued until October 6, 1958. The lifetime of both transmitters was shorter than expected, but natural exhaustion of the batteries rather than transmitter malfunction was considered the most likely explanation.

Analysis of the telemetry data received from Explorer 4 immediately confirmed the existence of a layer of intense radiation surrounding the Earth, starting at about 600 miles from the surface and increasing in intensity to at least the initial apogee height of about 1,400 miles. Moreover, when lines of constant radiation intensity were drawn on cross-sections of the Earth taken through the Poles, the contours turned away from the Earth at the higher latitudes in both northern and southern hemispheres and showed symmetry about the Earth's magnetic axis. This added considerable strength to the theory that the intense radiation found above 600 miles was connected with the Earth's magnetic field.

Van Allen suggested that this radiation surrounded the Earth in the form of a belt, rather like a torus, symmetrical about the Earth's magnetic axis, thus leaving the polar regions free. He further postulated that the radiation consisted primarily of electrons and protons, temporarily trapped in the Earth's magnetic field, and that these particles spiral along the lines of magnetic force. As the particles approach the higher latitudes and the lines of force converge rapidly, the pitch of the helix described by the particles becomes progressively less until eventually the particles are reflected at "mirror points" and start on a return journey to the other mirror point in the vicinity of the other magnetic pole, where they are again reflected (Fig. 2).

The lifetime of these particles is proportional to the square of their energies and as their energies fall, due to collision and atmospheric scattering, the altitudes of the mirror points are reduced. The effect of this is to increase the collision rate and scattering so that lifetimes are even more rapidly reduced. The lifetime of a typical electron of 1 Mev is believed to be of the order of 2 or 3 hours for a mirror height of 250 miles and about 10 days for a mirror height of 600 miles. However, the energies of the particles vary greatly between tens of thousands and tens of millions of electron volts.

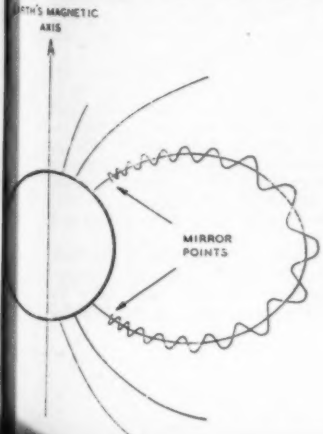
A special job for Explorer 4 was the investigation of the intensity and location of electrons artificially introduced into the Earth's magnetic field in Project Argus. Under this project three atomic devices were detonated in late August and early September 1958 about 300 miles above the South Atlantic, and close to the orbit of Explorer 4. These detonations released high-energy electrons by the radioactive decay of fission fragments and neutrons. Data radioed by the satellite showed that, as expected, a temporary thin belt of electrons had been created around the Earth.

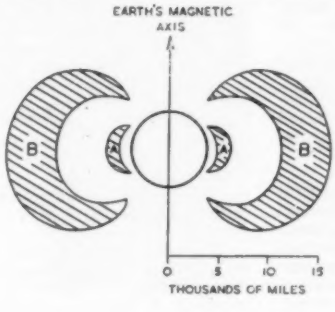
On December 6, 1958, the Americans launched their space probe Pioneer 3. This probe indicated that the intense radiation extended to about 3,000 miles from the Earth's surface, and that there was in addition a second belt lying between approximately 8,000 and 13,000 miles. Beyond this there was a gradual decrease of intensity (Fig. 3). More recently a preliminary analysis of data from Explorer 6, the paddlewheel satellite, has suggested that the pattern of radiation belts may be even more complex than previously suggested by Van Allen.

The origin of the particles in the radiation belts is uncertain. Van Allen has suggested that they come from the Sun, and it has also been suggested that the particles are by-products of the interaction of cosmic rays with nitrogen nuclei and oxygen atoms. But although their origin is uncertain, their existence is now undisputed.

A. E. and D. E. SMITH

Fig. 2 (left), spiralling motion of trapped particles about a line of magnetic force; Fig. 3 (right), the Van Allen inner (A) and outer (B) belts of intense radiation





MAX HOLSTE'S LATEST ON THE GROUND AND IN THE AIR

By MARK LAMBERT

Super Broussard Breaks Through

IT is now clear that the Max Holste Super Broussard is going to make its name in the world market. It has been selected for full support by the French government, it is based on a world-wide survey of operators' requirements, it has been designed to comply with the latest stringent airworthiness requirements and, as I discovered during a recent visit to Rheims, it is a real pilot's aeroplane to fly. Production is now in its initial stages and military orders seem likely.

Behind the Super Broussard lies a remarkable success story. Max Holste himself, one of the school of dedicated French aircraft designers, struggled for years with a variety of designs which more or less met some civil or military requirement. But, unlike many of his fellows, he was able to combine a flair for design with the equally important ability to appreciate market possibilities. Success first came within reach in 1951, when he produced the MH.152, an artillery observation machine, the prototype of which has recently been re-engined with the first Turboméca Astazou. It was touch and go at the time whether this or a rather more capacious utility aircraft was really needed. Holste withdrew into a hotel room and, as he says, considered the matter alone over a quiet bottle of brandy. Next morning he had decided on the larger utility, which became known as the MH.1521 Broussard.

Quite suddenly his little company received a military order larger, in terms of numbers of aircraft, than any placed in France since World War 2. The struggle became one of meeting schedules rather than of finding work, and Holste has never looked back since. He was sure that the Broussard fitted the bill and on his intimate knowledge of the civil market he based a successful civil sales campaign.

So the little factory at Rheims, and Sipa as sub-contractors, began to hum with production to meet the near-panic orders of the French government for the Algerian war. Even Broussards already delivered to civil customers were recalled for military service. Max Holste was home and dry; he can count on Broussard production for some years to come, and about half the total order of 400 have been delivered to date.

By flair and by happy chance, Max Holste had made the big league. In 1957 he began to plan a new aircraft—the stage where firms often come unstuck. But he has again made the grade. Starting with two round-the-world journeys talking to more than 500 feederline operators, he inquired into the prospects for a simple and cheap twin-engined transport. At first it was a ten-seater; but operators did not want it. Their requirement was for about 20 seats; and 30 was too many. For three years we have watched the resultant project progress, first to the mock-up shown at the Paris Salon in 1957 and then to the piston-engined MH.250 prototype which took the air on May 20 last and flew at the Salon in June. The definitive MH.260 turboprop transport is to fly early next year.

Some time ago the French government took an interest in the Super Broussard and wrote a specification round it. One factor was that it should be able to use any field over which a jeep could safely be driven at 30 m.p.h. with a tyre pressure of 35 lb/sq in. This dictated the Super Broussard's strength factor of 4.5, almost twice that required by CAR. 4b. The government also supervised the design of the structure to the latest fail-safe and rip-stopping standards. Finally, and most significant of all, the Super Broussard has won government financial support (to the exclusion of several other types, including the Dassault Communauté). So the Super Broussard is truly launched.

The present situation is that the French government has paid for the first prototype, now flying with 600 h.p. P. & W. R-1340 (Wasp) piston engines. It has also ordered a pre-production batch of five Bastan-powered Super Broussards. One will be the structural-test specimen; the subsequent machines are to fly next March, May, July and October, the first for C. of A. certification, the second for demonstration and the last two for route-proving. There is also a well-found rumour that the government is pre-financing a batch of 100, and the chances of a military order in the near future seem excellent. Holste has signed an agreement whereby Nord Aviation's well-equipped factory at Méaulte will produce major portions of the first five airframes for assembly and equipping by Holste at Rheims, production of the airframe being subsequently divided so that Nord make 72 per cent and Holste the remainder. Production is to build up to four or five per month by March 1962.

Already very considerable commercial interest has been shown in the Super Broussard and, in addition to the smaller companies all over the world, large airlines are investigating it as a feeder-liner. Max Holste based his design on the theory that the DC-3 must be replaced by two distinct types. On the one hand, there is the "good airfield" airliner with turboprops, pressurization and about 40 seats. On the other, there is the 20-seater with equal passenger appeal, but capable of doing a real transport job from semi-prepared bases, and simple and cheap to operate.

During my visit I questioned Holste closely about his possible rivals. He replied that the Super Broussard had none—and that was one of the reasons why the French government had decided to give it their full support. Both the Twin Pioneer and Caribou were more specialized projects and the Avro 748 and Fokker Friendship were well up the scale into the "proper airliner" class. To a slightly lesser extent, the same applied to the Dart Herald. Max Holste was not inclined to countenance a future development of the Super Broussard with Darts. His aircraft would grow with the Turboméca Bastan, which was already making its name and for which there is now very considerable government support. By 1961 the Bastan will be giving 1,200 s.h.p. In addition, another version of the Super Broussard, designated MH.280, is to be offered with de Havilland Gnomes. Current estimates are that the Super Broussard with Bastans will sell for £82,000 fully equipped. The military MH.260M will have clamshell rear doors.

These are the background and prospects of the Super Broussard; but my main purpose in going to Rheims was to fly the P. & W.-powered prototype. I flew comfortably over from Fairoaks in *Flight*'s Gemini and met Pierre Clostermann, Holste's associate. With André Jouannet, assistant test pilot, we settled down to inspect the aircraft. It seemed to sit very high on its close-coupled nosewheel undercarriage, giving ample ground-clearance. The large, low-pressure tyres were obviously good for rough grass. The nosewheel was self-centring but not steerable, toe-operated hydraulic disc brakes at the mainwheels serving for this purpose. Though the mainwheel track appeared narrow, the track/span ratio is 50 per cent greater than that of the Lockheed Hercules, and a torsion bar connecting the two suspensions ensures lateral stability. All units retract hydraulically, the nosewheel forwards into the beaky nose fairing and the main wheels into lateral bulges. On the MH.260 the apertures in these bulges will be covered by doors to give 11 kt increase in cruising speed. The gear may remain down at any speed, but at present the nosewheel doors limit transit speeds to 100 kt.

All control surfaces are fabric-covered, because this eased the task of balancing and saved weight. The elevator is balanced at 50 per cent static load, so that on the ground the stick drops forward out of the way. Trim tabs are fitted to the port aileron, rudder and elevator, and the tail surfaces have geared tabs in addition. The double-slotted flaps are hydraulically lowered to a maximum of 45 deg. Just about the only modification made throughout the test programme has been an increase in fin size, and the rudder trim-tab is to be doubled in area in production aircraft.

The wingtips are formed by small bullet fairings which look neat, produce an aerodynamically efficient tip and form a ready-made attachment point for tip-tanks, should these later be required. A spacious and wide cabin leaves room, in the MH.260

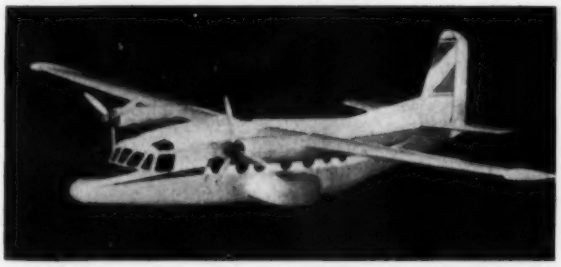
The model at right and the air-to-air view opposite show the essential differences between the MH.250 Super Broussard prototype with P. & W. R-1340s and the MH.260 production aircraft with Turboméca Bastans

which is to be 71in longer, for 23 Air France tourist seats, together with a toilet at the rear and a galley in front. A large baggage space aft is reached through a big door on the starboard side. The main entrance door to port is in two halves, for passenger or freight-loading use. A further door leads directly to the co-pilot's seat so that the crew may get in easily when the cabin is full of freight.

Max Holste particularly emphasized that the feederliner must have passenger appeal, both externally and internally, even though it may be operating from small grass strips. There is no reason why a main-line passenger should suffer discomfort in his final feederline stage to the back of beyond. The Super Broussard will certainly not disappoint him, or, for that matter, the crew which flies him.

External photographs only just do justice to the big, comfortable flight deck and ample windscreen. Additional roof windows afford good view in turns and the nose slopes sharply away in front. Full marks for visibility and working space. The layout is no less good. Adjustable seats leave the pilots close to the central console which is L-shaped to give the captain the advantage in reaching throttles and trim wheels, while the co-pilot has radio, cowl-flaps and other items nearer to him. There are two big ashtrays and plenty of room for maps, cups *et al*. The prototype has dual controls with toe-brakes to port only, and a single instrument panel including I.L.S., radio altimeter and A.D.F. indicators. The A.S.I., horizon and single-needle-and-counter altimeter are repeated above the engine instruments for the co-pilot, the second A.S.I. being calibrated for low speeds and the main one for higher speeds. Trim-position indicators are next to their wheels. Beneath the engine instruments is a single bank of levers, serving throttles, pitch and feather, mixture, fuel selection and cross-feed, and oil and fuel cut-offs. Shaped gear and flap levers with their indicators are next to the main blind-flying panel.

Max Holste designed his own power egg for the P. & W. 600 h.p. piston engine with twin exhausts emerging above the nacelle and cooling provisions for tropical conditions. The installation is very successful and it is reported that Scottish Aviation have shown interest in it for the Twin Pioneer. The three-blade propellers are by Ratier Figeac, who will supply the propellers for the Bastan. Compressed air at 170 lb/sq in applies feathering power, normal pitch control being electric.



Typical of the care taken to ensure ease of maintenance are the hydraulic and electric centrals behind the co-pilot, concentrating all regulators and reservoirs in a single bay. Opposite are the radio racks with room for full airline equipment. All electrical and instrument panels have quick-release fasteners and hinge down to give immediate access to the back of all such installations. Another feature is the provision of plastic windows in the flap shrouds to allow rapid visual inspection of the flap actuation.

Having ascertained these features, André Jouannet, Pierre Clostermann, flight engineer Roger Fauriat, and I boarded the Super Broussard and warmed up the engines. Jouannet then taxied out onto the 700 metre-long rough grass runway and lined up for take-off. Immediately apparent were the powerful brakes, effective steering and the extremely smooth ride the undercarriage gave. Earlier, the Gemini had rattled and bumped a good deal on the same surface. Jouannet opened up and unstuck at 66 kt after 13 sec and climbed steeply at 90 to 100 kt and over 200 m/min (650ft/min). We were flying at 6,750 kg (14,880 lb) with the c.g. at 27 per cent s.m.c., or about neutral. With a setting of 2,100 r.p.m. and 107 piez (31.6in Hg) we climbed at 980ft/min at 92 kt and the low noise level and good visibility, particularly downwards and upwards through orange roof windows, became immediately apparent. The side window could be wound back for direct vision and admitted very little draught when open.

MAX HOLSTE MH.260 SUPER BROUSSARD
(Two Turboméca Bastans giving 957 b.h.p. each

Span, 71ft 8¼in; length, 58ft 1in; wing area, 592 sq ft; aspect ratio, 8.8; empty weight, equipped, 10,134 lb; maximum gross weight, 21,016 lb; fuel capacity, 3,307 lb; passenger load for 497 mile stage, 23; freight load for same stage, 7,496 lb.

Performance at 18,078 lb in I.S.A.: single-engined sea-level climb at max. continuous power, 433ft/min; max. continuous-power speed at 9,842ft, 213 kt; cruising speed at 75 per cent power, 205 kt; stalling speeds, respectively with and without flaps, 48 kt and 75 kt; landing distance from 50ft, 1,279ft; braking run, 853ft; take-off ground run with 30 deg flap, 705ft; take-off distance to 50ft with 15 deg flap, 1,296ft.

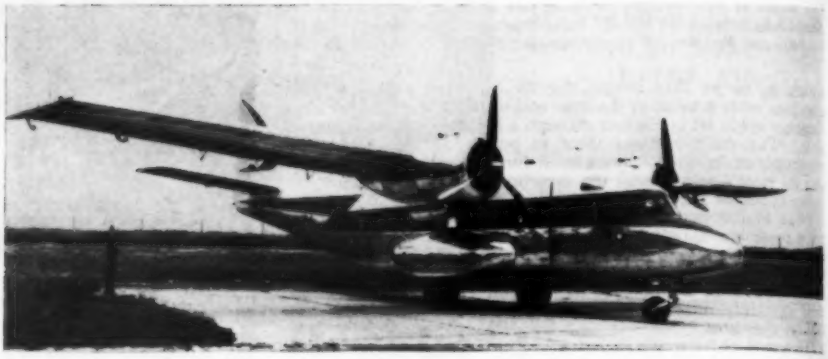
This was a first taste of the Super Broussard as a pilot's aeroplane. The second came when I took control, cruising at 4,200ft, 145 kt, 1,970 r.p.m. and 90 piez (26.5in). Although it flew steadily hands-off, the aircraft invited fighter-like manœuvring. Control was crisp and light and co-ordinated turns could be made with rudder alone. Longitudinal stability was correct but did not feel in the least artificial. A very slight sponginess in the ailerons, which I did not immediately notice, is caused by a cable-tensioning method which is to be altered in production aircraft. The easy manœuvrability of the Super Broussard is an excellent adjunct for bush flying.

I slowed the aircraft down to 90 kt clean and the nose came well up. Lowering of the undercarriage caused first a slight nose-up and then a slight nose-down trim change, which virtually cancelled themselves out when the gear was fully down. All flap settings caused a nose-up change. There was more than enough elevator trim to cancel them out. Gliding at 75 kt with everything down we descended at 300 m/min (980ft/min) with the ailerons still crisp, but the rudder becoming very slightly sloppy. I then applied power and flew straight and level right down to 48 kt with no sign of a stall. Holste pilots have flown at 40 kt—which is a most remarkably low speed for an aircraft of this size. It feels rather like an outsize Chipmunk at such speeds with effective aileron control remaining all the time.

It seemed hardly worth trying an actual stall and we passed on to single-engined flying. Jouannet cleaned the aircraft up and cut the starboard engine at 140 kt, feathering by pulling the pitch lever back through a gate. With 2,100 r.p.m. and 100 piez on the good engine the speed stabilized at 105 kt, trimmed hands-off with little rudder trim. We restarted the starboard engine hands-

The captain's position in the MH.250 prototype. Engine instruments and co-pilot's flight instruments are in the centre, above the full range of engine and fuel control levers. Aft are magneto switches, cowl-gill controls, trim wheels and radio selecters. Flap and gear levers are next to the captain's blind-flying panel which includes I.L.S., radio altimeter and A.D.F. dial. All panels hinge downward for maintenance. Test gear is attached to control wheel and rudder pedals

SUPER BROUSSARD BREAKS THROUGH . . .

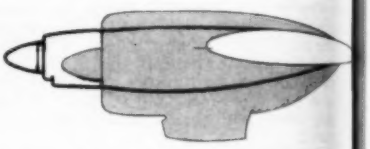


The Super Broussard sits high on its undercarriage, but gives an exceptionally smooth ride on rough ground. It can negotiate any surface over which a jeep can safely be driven at 30 m.p.h.

off and let it idle for some time while oil and cylinders warmed up with the gills closed. I then took over, set climbing power at 90 kt and trimmed out. At a signal from me, Jouannet cut the port engine (the less favourable one) and feathered immediately. There was a lurch as the power went, but I was able to trim hands-off straight away and let the speed stabilize again at 105 kt. This was at 2,000 m (6,500ft) and we had no difficulty maintaining height. Steep turns in either direction were absolutely normal and control harmonization remained. In fact the Super Broussard could be flown perfectly normally on one engine and was fully manœuvrable. Finally, I pulled the speed back to 80 kt, by which time we had just run out of rudder trim and had applied some aileron and elevator trim. Still the aircraft handled impeccably and the residual foot loads were not excessive. The doubling of the rudder trim-tab area on production aircraft will allow hands-off flight at these speeds despite the more powerful turboprops.

Single-engined handling is certainly not hard work and I set off for St. Léonard's 700 m grass strip to try some landings. Down-wind at 80 kt I lowered 20 deg flap and gear and made a curved approach at that speed. Elevator control was very precise and visibility perfect. Attitude was quite normal. Lowering full flap, I noticed the strongish nose-up trim change and great increase in drag, so that I applied power, but at 75 kt the landing was very simple. The aircraft sat down with little float and stayed down, and the nosewheel could be dropped on or held off as required. Jouannet immediately applied the brakes hard and we came to rest in about 300 yd, a satisfying performance on a first attempt. That undercarriage is splendid.

We back-tracked and I took off, using engine to keep straight for the first few yards before the rudder bit (I had no brakes on my side). The column came naturally back off the forward stop during the run and lifting off was straightforward, with a smooth transition to the clean climb. A second landing worked out very much like the first, again with markedly good visibility and precise control ending in a superbly cushioned touch-down and smooth, short ground-run. I could pull the throttles smartly shut just before rounding out without any sink. André Moynet, Holste's chief test pilot, is a virtuoso on Super Broussard and I heard tales of his spectacular landing performance off steep side-slipping approaches. The aircraft certainly felt as if you could treat it that way without being bitten. Its behaviour during a series of official trial I.L.S. approaches had apparently been exemplary and it maintains positive longitudinal stability with a c.g. 37.5 per cent aft of s.m.c. It can be operated in 90 deg cross-winds of 30 kt. Accelerate-stop distance is little over 650 yd including 190 yd deceleration distance. The V_2 speed is 80 kt



The difference between piston and turboprop engines . . . half the volume and potentially twice the power

with 10 deg flap and 73 kt with 20 deg. Rate of roll at cruising speed is 25 deg/sec and 20 deg/sec in landing configuration. During tests, landing runs of 197 yd on grass and 131 yd on concrete have been achieved. The field length in the very difficult SR.422 B landing case is 800 m (875 yd) with allowance for grass or wet runway.

Although the MH.260 will be larger and heavier, the effectiveness of the flaps will be maintained, partly by slightly altering the flap hinge-point and partly because of inherently increased effectiveness with the very much smaller turboprop nacelles.

For an aircraft of relatively specialized performance, the Super Broussard is remarkably pleasant to handle and has no tricks. The flight deck is comfortable and large, with ample visibility for small-field operation. Undercarriage and brakes are outstandingly good and the whole airframe is tough, simple and intelligently laid out, but still preserves real airline passenger appeal. I think the French Government has backed the right horse—and many operators already seem to agree. Max Holste is sufficiently aware of the customer-relations angle and has effective financial and industrial backing to make a real go of it.

THE HURRICANE STORY NEWLY TOLD—AND CRITICIZED

The Hurricane Story, by Paul Gallico. Michael Joseph Ltd., 26 Bloomsbury Street, London, W.C.1. Price 12s 6d. Illustrated.

IF there is one great aeroplane which deserves to be enshrined in a great book it is the Hurricane. Not because it was a particularly revolutionary aircraft, as Mr. Gallico asserts, but because (as he also asserts) "she was loved and trusted by every man who ever knew her." Of more practical consequence, the Hurricane was a great war-winner.

Mr. Gallico has erred in confusing greatness with Hollywood glamour. Even in a book such as this it is not *quite* true to say that "she was a ruthless and total destroyer . . . unique in the heavens." It is probably not quite true either that on the occasion of the Hurricane's first flight all those years ago Bert Hayward (rigger, chain-smoking) declared, "This must really be something out of this world with all the hush-hush. They say old Camm has been nursing it like a new-born baby." Nor is it *quite* proper to allude to the Hurricane as a "ship," as the author persistently does. Probably it is not strictly accurate to record that ". . . Camm and his associates knew that the double-decker fighter plane could not be pushed through the air one r.p.m. [sic] faster than the 250 m.p.h. they were then getting out of the Hawker Fury . . ."; for biplane fighters achieved far higher speeds. And it is, surely, sensationalism to write, "Major Buchanan listened to what the designer had to say. He studied the blueprints and what they told him was both novel and startling. Here was a heavier-than-air machine with, to begin with, an air-frame of totally different structure and design. If it ever got up off the ground it would fly faster than anything heretofore seen."

The suggestion that Dick Reynell's exhibition of the Hurricane at Brussels shortly before the war was the cause of a Jungmeister crashing is a slur on a brave pilot and a fine aeroplane; and the following passage describing S/L. Gillan's Edinburgh-Northolt flight surely verges on something even more distasteful: ". . . it seemed that the tortured wings must be torn from the fuselage . . . The agony the aircraft was undergoing now was reflected in Gillan, who said to himself, 'Oh, Lord, I'm going to be sick.' But the Designer of Man as well as the designer of machines had not shaped His creation to lose heart, quit or fail . . . Gillan fought off nausea and fatigue and continued his battle of the controls . . ."

The present writer has been less successful than John Gillan in fighting off the nausea.

One could add that the book irritates by its careless and alien renderings of familiar names and designations ("M.E.110", "Squadron 504", "Heinkel III"); and other criticisms could fairly be adduced. It would be pleasing to be able to report something fine and individual about this narrative, having regard to the distinction of the author and the eminence of his theme. But the book is a misfit and a misfire, and for the Hurricane it simply will not do.

H. F. K.

JAVELIN AGAINST THE SUN
Cpl. Magee, Wattisham

TRAIN ON THE TAY BRIDGE
Cpl. A. Dodds, Leuchars

FIGHTER COMMAND PRESENTS . . .

. . . its first-ever photographic competition, from which these prize-winning entries are reproduced. There were twelve classes, ranging from air-to-air pictures to portrait studies, and all the photographs submitted were exhibited for a week at Fighter Command headquarters, Bentley Priory, Stanmore. The individual winner was Cpl. Attenborough of Old Sarum and the inter-station cup was won by R.A.F. Leuchars

MOSQUITO AND JAVELINS
Cpl. N. F. Cox, Chivenor

HALL OF BENTLEY PRIORY
S.A/C. Hagell, Stanmore Park

Jet-flap Helicopters

M. DORAND ADDRESSES HELICOPTER ASSOCIATION

FOR some years past, R. Dorand, the eminent French rotary-wing engineer and founder of Giravions Dorand, has been investigating the application of the jet-flap principle to helicopters. Last Friday, November 6, he was reading a paper on the subject before the Helicopter Association of Great Britain, and in it he outlined what such systems can achieve when applied to different types of helicopter. Unfortunately the English translation is so poor that it is often much more difficult to follow the arguments than would have been the case had no translation been attempted.

In his introduction the author enumerated some of the principal technical handicaps suffered by conventional helicopters, and suggested means whereby these might be overcome. The first suggestion was to employ super-circulation at the tip of the retreating blade; other solutions consisted of imposing on the conventional cyclic-pitch control an additional multicyclic control, either mechanically or by the use of jet flaps. The latter were shown to be greatly preferable.

In effect, irrespective of whether the rotor was driven through jet reaction or by shaft-power at the hub, M. Dorand showed that with jet-flap control the blades need have no articulation other than simple flapping in the vertical plane. Blade pitch was fixed, which simplified rotor-head construction and facilitated passage of air into the blades. The air was ejected along the trailing edge and the resultant fluid layer controlled by any suitable means. Most of the author's test results were obtained with an inflatable spanwise rubber extrusion, reminiscent of a pneumatic de-icer boot, which when inflated increased the mean deviation of the jet.

Designated DH-G.5, one jet-flap rotor has been extensively investigated by ONERA in the big tunnel at Chalais-Meudon. It was found that by progressive increase of the "flap" angle up to 40 deg the mean rotor lift coefficient could be raised from the usual level of around 0.4 to as high as 1.5. The optimum ratio of achieved L/D ratio to the optimum L/D ratio of a conventional helicopter corresponded to a mean rotor lift coefficient of about 0.9. In addition the values of "parameter of advancement" (cruising speed divided by tip speed) might reach 0.7—roughly twice the usual level—without giving rise to serious vibration.

In the next section the author outlined the performance of seven hypothetical jet-flap helicopters with cruising speeds between the limits of 210 and 400 km/hr (130 and 249 m.p.h.), all having tip drive and some having propulsive propellers (i.e., falling into the gyrodyne class). After exhaustive analysis, he concluded that the substitution of jet-flap control made possible the following advantages: mechanical simplification, owing to the fixed blade angle; drastic reduction of servo-control forces; increased flight speed without the use of propellers; increase of rotor power and rotor L/D ratio; in cruising flight, reduced vibration and stresses subject to reversal; and the possibility of increasing disc loading by about 100 per cent and of flying at speeds up to 310 km/hr (242 m.p.h.) without resorting to an auxiliary wing.

BACK-ROOM ALLOYS

FROM time to time over the past fifteen years this journal has recorded the salient characteristics of the successive types of high-nickel alloy which the Mond Nickel Co. and Henry Wiggin & Co. have respectively developed and manufactured for innumerable applications, involving high stress, elevated temperatures and a corrosive environment. From the aeronautical viewpoint the most important of these are the Nimonic series of wrought alloys, which have for many years been virtually the standard material for the hot parts of British gas turbines—and in particular for turbine rotor blading.

In the past Mond Nickel made a practice of not divulging data on any new alloy until the material was commercially available. However, it is now their view that the technology of designing high-temperature machinery—and gas-turbine powerplants in particular—is so critically dependent upon advance knowledge of the materials likely to be available some years hence that they have decided to release data on some entirely new alloys which are almost unknown outside their own research laboratories.

Unlike their predecessors, the new alloys are produced by melting *in vacuo*. By this means high-temperature qualities may be still further improved, particularly if the composition is adjusted to take full advantage of the improved purity which vacuum melting allows. Following considerable research in this direction, Mond Nickel have selected five alloys whose properties, determined on charges melted in the laboratory, are sufficiently encouraging to initiate work on quantity production. Three of these alloys are wrought, and may eventually be sold as additions to the Nimonic range. At present they are known as experimental alloys M.14V, M.15V and M.16V. The other two are casting materials, which would be marketed under the trade name of Nimocast; at present they are designated M.4VC and M.6VC.

To be suitable for service at high temperatures all alloys must fulfil a number of test criteria, including resistance to creep, fatigue, corrosion and thermal shock. Moreover, when full production is achieved the alloy must be consistent both in design properties and in response to fabrication techniques. The potential of the new materials is immense, and a clear indication of their qualities may be assessed from the accompanying tables of data determined on experimental melts.

1: Stress (tons/sq in) for 100 hr life of Nimonic 100 and M.14V

deg C ➤	870	940	980	1,020
N.100	12.4	7.1	4.2	2.0
M.14V	17.0	9.2	5.9	3.8

2: Max. stress (tons/sq in) of Nimonic 100 and M.14V

deg C ➤	20	200	400	600	700	800	900	1,000
N.100 ...	81	76	73	73	67	47	26	8
M.14V ...	73	70	68	69	68	58	52	16

3: Fatigue data of Nimonic 100 and M.14V

Test ➤	Rotating-bend fatigue (± 30 tons/sq in, 750 deg C)	Cycles to fracture (± 10 tons/sq in, 980 deg C)
N.100 ...	15	30×10^6
M.14V ...	40	37×10^6

4: Resistance to sulphur attack; loss in weight (mg/cm²) after one hour in 0.5% Na Cl (environment A) or 25% Na Cl (environment B), balance Na_2SO_4 in each case

environment ➤	A, 900 deg C	B, 900 deg C	A, 1,000 deg C	B, 1,000 deg C
N.100	0.24	116	0.24	145
M.14V	0.29	0.86	0.61	1.65

5: Life (hr) at 7 tons/sq in at high temperature of wrought alloys

deg C ➤	940	980	1,000	1,010	1,040
M.14V ...	250	30	10	—	—
M.15V ...	—	120	90	40	—
M.16V ...	—	—	170	100	20

6: Standard deviations, 100 hr life, M.4VC

deg C ▼	tons/sq in	std. deviation
815	28	0.75
980	8.5	0.56
1,020	6	0.37

7: Stress, 30 hr life, M.6VC

deg C ▼	tons/sq in
815	30
940	14
980	11
1,040	6.5

SURVEYING THE MEKONG

ALL Canada's principal air survey companies are participating in an irrigation and hydro-power survey of the Mekong River in South-east Asia which Canada is financing under the Colombo Plan. The work, which is scheduled to begin this month and will take two years, includes air photography, ground survey and map compilation. The photographic Survey Corporation Ltd. of Toronto, which has undertaken similar Colombo Plan work in Asia, has been awarded a contract to act as management engineers. Companies which will participate with P.S.C. include Aero Surveys Ltd., Canadian Aero Service Ltd., McElhanney Nelson Air Surveys Ltd., La Compagnie Photo-Air Laurentides and Spartan Air Services Ltd. A 1,600-mile stretch of the Mekong is being surveyed, extending from the Laotian-Burmese border to the South China Sea. Between May next year and December 1961 topographic and engineering maps of it are to be produced by the participating survey companies.

Straight and Level

TEN Conservative M.P.s have signed a motion saying that the House of Commons "deplores the action of British European Airways in drastically reducing the size of the national flag on its aircraft." The proposer is Mr. Geoffrey Stevens (Portsmouth, Langstone).

When I read this in the newspapers, one of which ran the headline "B.E.A. CUT THE FLAG TO HALF SIZE," I rang my old friend Sir Charles Boost, firebrand champion of British supremacy in the air, for his comments.

"I'm glad you rang, old man. You can say in your column that I am most dreadfully shocked, and that I am 500 per cent behind these splendid Tory patriots. I am hoping they will join me in my plans to tar and feather all B.E.A.'s aircraft forthwith . . ."

I suggested that some people might think that this sort of behaviour was suggestive of a national inferiority neurosis, and I asked whether he did not agree that the new nose position of the flag, which is actually only slightly smaller, was now more prominent anyway?

"Rot, rot, rot!" Sir Charles bellowed. "The size of the flag is the only thing that matters in British air transport. Soon you'll be telling me that B.E.A.'s job is to run an efficient airline and to make profits and all that poppycock. I tell you, old boy, B.E.A.'s job is to win prestige for this grand old country of ours and to show the flag. For heaven's sake let's put first things first, old boy . . ."

● Last week B.E.A. were in political hot water because of something else; maps they have been supplying to passengers show a shaded area of Germany as being "under Polish administration." This brought forth from the West German Federation of Expellers (I am not quite sure what an expeller is, but am quoting from a B.U.P. report) the following statement:

"B.E.A. is known to be making good business, particularly with its Berlin flights," the Federation said. "It will, therefore, not be difficult for Bonn to take up arms against this affront. Every German air passenger is now able, through use of other airlines, to hit Britons where they are most sensitive—in their purse."

The Foreign Office found themselves involved, and felt constrained to say that Britain "stood by the Potsdam Agreement," the treaty which provided that the final delineation of the western frontier of Poland should await a peace settlement.

New B.E.A. passenger maps show the German frontier as being along the Oder-Neisse line; and after consultation with the Foreign Office, B.E.A. have added the words: "These maps are for the convenience of passengers and have no political significance."

Meanwhile, B.E.A. still manages to remain in business.

● There comes a time when a person or an organization or a thing gets so much adverse publicity that, from that time on, it can do no right. The witch-hunting powers of papers like the *Daily Clanger* is such that dogs very frequently get bad names, not always when they deserve it.

For example, B.E.A. is the "unpatriotic airline," always doing something frightful to the flag. And B.O.A.C. is the "inefficient airline," always losing money.

The B.E.A. flag business, which Sir Charles Boost comments on in col. 1, needs no further comment—except perhaps that the *Daily Clanger* is doing far more harm to the flag than ever B.E.A. have done.

So far as B.O.A.C. are concerned, this Corporation recently emerged from the annual I.A.T.A. fares scrimmage—slightly battered—as the sole proponents of lower fares. They have been given only grudging credit for this. I know there were misgivings about their I.A.T.A. boat-rocking methods, and that they are not the only airline that wants lower fares. But B.O.A.C. had the guts to make an issue of the matter, and for my money they are the champions of a cause to which others pay only lip service.

And more credit where it is due: B.O.A.C.'s house is well on the way to being put in order. If all goes well, and their costs continue to decline at their present rate, they should be making a profit within a year or two.

● The projects staff of a British aircraft company state that more than 95 per cent of all airline stage lengths are less than 1,000 miles. They further argue that an *even higher percentage of passenger-miles* are flown on stages of less than 1,000 miles.

Steady: I must think carefully about this.

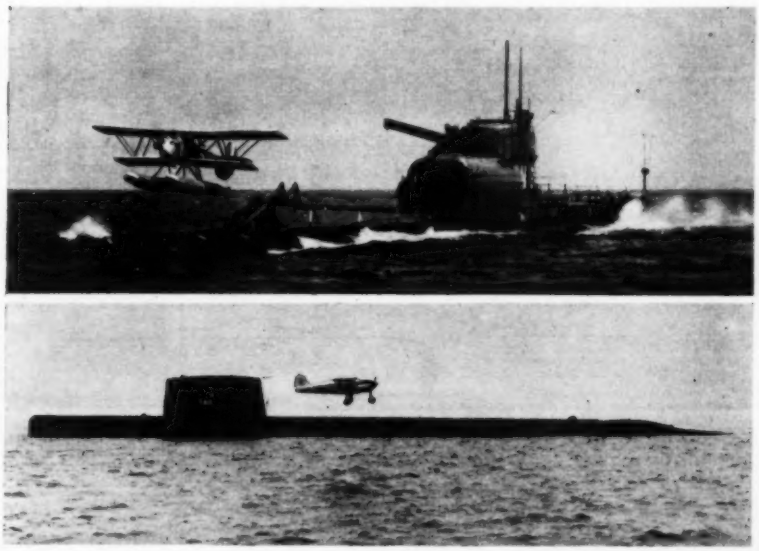
In point of fact, the percentage of passenger-miles flown over stage lengths of less than 1,000 miles was, in 1958, 59 per cent (*Flight*, August 21, 1959, p. 40). That's for the whole world: for the U.K. airlines the figure can be worked out from Board of Trade traffic statistics (July 4, 1958, p. 30) as 31 per cent.

Still, it sounds good to say that your aeroplane is designed for stage lengths below which most passenger-miles are carried. But for the record, 95 per cent of the world's passenger-miles are carried over *stages of below 3,000 miles*. No wonder they sell so many of these big jets.

● "Ford Motor Co., and Coca Cola are said to be among several big companies considering orbital advertising—using privately owned satellites to beam taped commercials to Earth."—*Missiles and Rockets*, October 26.

ROGER BACON

Do you remember those famous *Flight* photographs (e.g., top picture) of the little Parnall Peto operating from the submarine M.2 in the early 1930s? When last week I received the lower picture, showing a Piper Tri-Pacer and the nuclear-powered U.S. submarine *Triton*, I thought that the Americans had gotten around to using the same technique. But I find that the Tri-Pacer was flying on a press assignment—taking pictures of the 447ft. 5,900-ton, twin-reactor, radar-picket monster



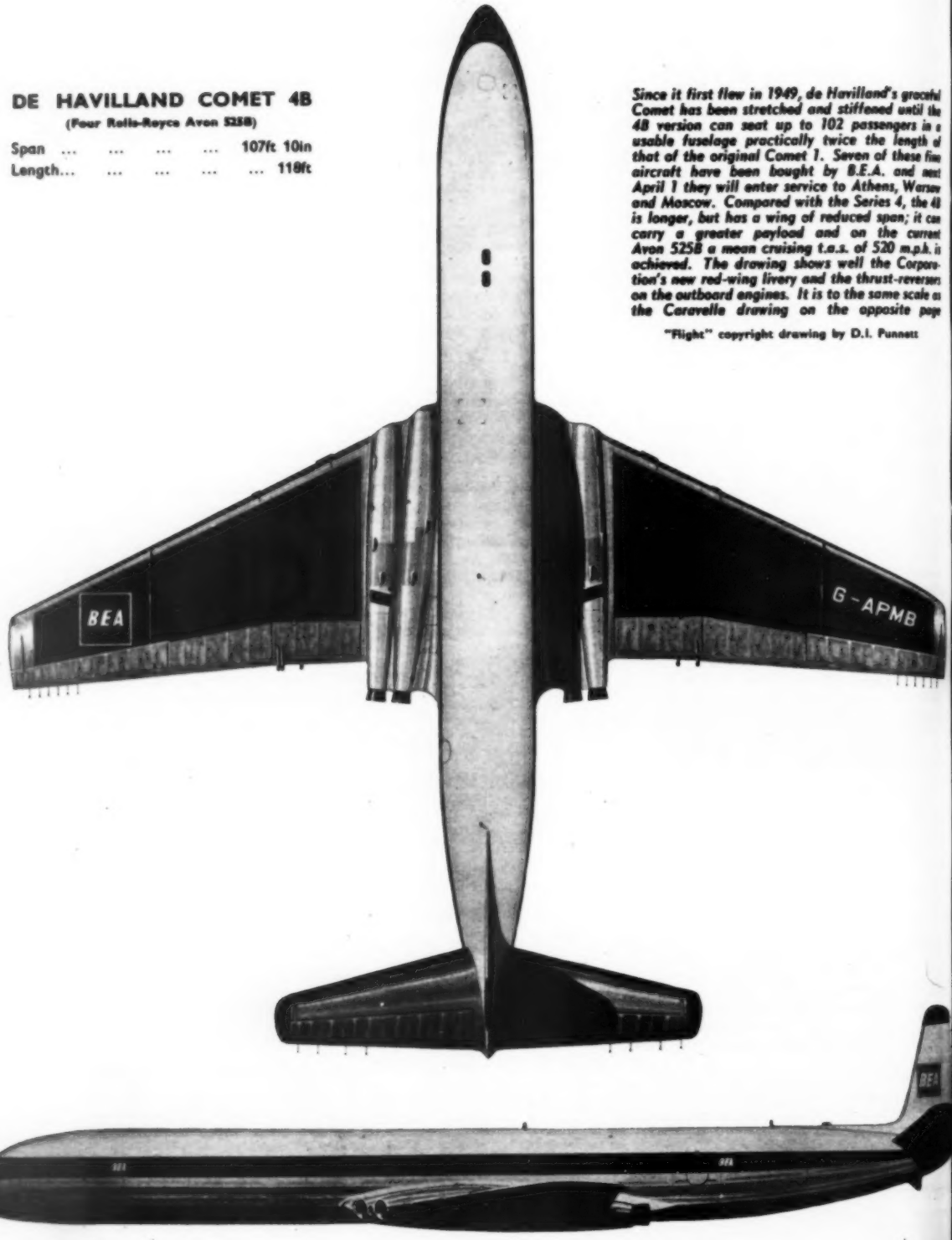
DE HAVILLAND COMET 4B

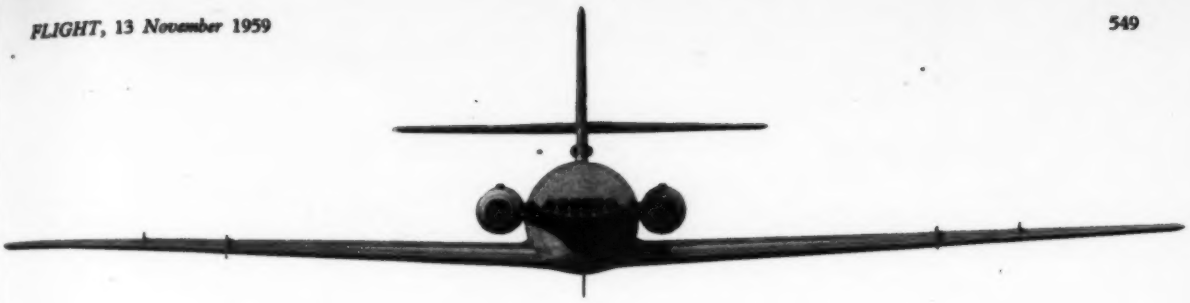
(Four Rolls-Royce Avon 525B)

Span	107ft 10in
Length...	118ft

Since it first flew in 1949, de Havilland's graceful Comet has been stretched and stiffened until the 4B version can seat up to 102 passengers in a usable fuselage practically twice the length of that of the original Comet 1. Seven of these fine aircraft have been bought by B.E.A. and next April 1 they will enter service to Athens, Warsaw and Moscow. Compared with the Series 4, the 4B is longer, but has a wing of reduced span; it can carry a greater payload and on the current Avon 525B a mean cruising t.a.s. of 520 m.p.h. is achieved. The drawing shows well the Corporation's new red-wing livery and the thrust-reversers on the outboard engines. It is to the same scale as the Caravelle drawing on the opposite page

"Flight" copyright drawing by D.I. Punnett





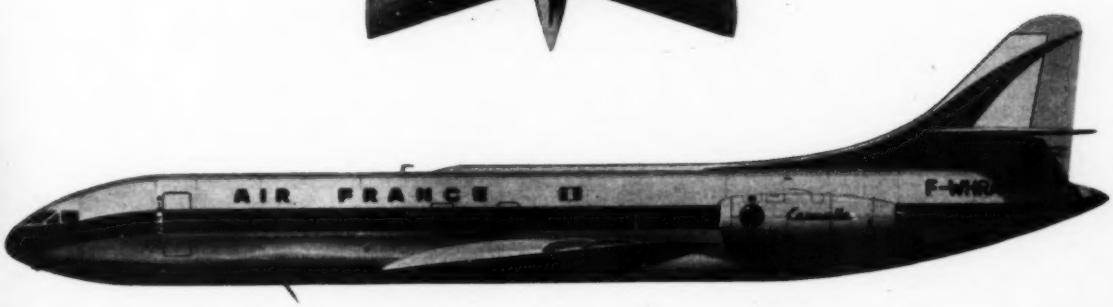
SUD 210 CARAVELLE 1

(Two Rolls-Royce Avon 522)

Span	...	...	112ft 6in
Length	...	...	105ft

The Caravelle is the magnum opus of the French aircraft industry, and the fact that more than 50 have already been purchased by eight airlines is striking testimony to its merits. Sud, assisted by a large proportion of the French industry and many British companies, flew the first Caravelle in May 1955 and made the first delivery last March. Already Air France fly these graceful 64/80-passenger machines on routes to London, Nice, Beirut, Milan, Rome, Athens, Istanbul and Tel Aviv, and Caravelles have also been delivered to S.A.S. and Varig (Brazil). Very soon substitution of the more powerful Avon 527 will permit re-certification at increased weight (Caravelle 3)

"Flight" copyright drawing by D. I. Punnett



THE PIED PIPERS

In the Air with the Colourful Comanche, Tri-Pacer and Super Cub

By MARK LAMBERT
and ALASTAIR PUGH

"FLIGHT" AIR-TO-AIR PHOTOGRAPHS

We can do it too. Our reproduction of a publicity calendar formation

THEY say that he who pays the Piper can call the tune. Just once in a while the tune can be called without paying—as we called it one day last month on the Piper business aeroplanes offered by Vigors Aviation at Kidlington.

We made an executive day of it. After the usual argument as to who should fly, three of us piled into *Flight's* Gemini at Fairoaks and set down at Kidlington. A strong wind was rapidly covering a cerulean sky with woolly grey cumulus, so we immediately went into a huddle with Tim Vigors and Toss Murray to see who should fly what for whom in a composite photographic formation. The results of cameraman Ian Macdonald's efforts through the open window of the Gemini (Pugh flying) decorate these pages.

After an hour's formation work on his first acquaintance with the Super Cub Lambert reckoned that the most difficult part had been getting into it—right foot on landing wheel, then corkscrew body into cockpit, left foot first. Ventilators and the ability to fly with the door panels open can keep one cool, or the heater can be switched on to produce a first-class fug.

About that in-flight openable door: people use the Cub to go shooting coyotes from the air wherever it is they have to suppress such beasts. We saw no coyotes at Kidlington, but Vigors and his men use the Cub to fetch breakfast from the neighbouring pub and they can carry their portable exhibition stand in the back when necessary.

With the classic Piper Cub airframe and that lusty 150 h.p. in the nose, the Super Cub (said Lambert) is an excitingly over-powered piece of fly-paper, and we thought it the most stimulating and safest genuine utility aircraft we have ever handled.

With the relatively heavy Lycoming it behaves just as one would expect. On a whiff of throttle and 2,300 r.p.m. it will cruise at 105 m.p.h.; open the throtte wide and things become noisy, but you can get from A to B without starving. The real joy of the Super Cub is its astonishing field performance (in the agricultural rather than the aeronautical sense). Its very eagerness to leave the ground is startling. There is very little swing and the rudder becomes effective straight away. As soon as the tailwheel lifts off you get airborne and thrust upwards to 4,000ft in under four minutes. All the way up to 5,000ft Lambert was laughing at Pugh, Murray and Vigors trying to catch up with him.

At 2,450 r.p.m. the Cub made 112 m.p.h. I.A.S. at 5,400ft. Laterally it was neutrally stable, though it would not readily stay level hands-off because the aileron wires had some play and friction. Longitudinal and directional stability were excellent. Hands-off at 110 m.p.h. Lambert pulled the thottle smartly shut (it has no friction device, but it stays where you put it) and the Cub settled into a steep glide after one-and-a-half phugoids. First flap-setting produced a strongish nose-up trim change and speed fell off very quickly. Trying to stall with power off, the Cub got its nose well up but if you hold the stick hard back it simply goes downstairs without actually stalling. At the third zoom there was a judder, but only at the fourth did a true stall occur. Applying full power in gliding-approach configuration caused a smart nose-up attitude change and rapid loss of speed, but there was ample control. With power on, the elevators were powerful enough to produce a stall somewhere below the 40 m.p.h. minimum reading on the clock; one wing may drop gently, but the stick can be held hard back.

Gliding at 40 m.p.h. in a 60 deg-banked turn there was not enough elevator to produce a stall. Application of power then brought the tail down well, but the stick forces were so high that a stall would be extremely hard to achieve.

Having satisfied himself about low-speed performance, Lambert tried some really hairy circuits, pulling off hard into a steep turn and wheeling round in the strong wind to land again in well under 60 sec from take-off. He did it several times, adding some full-blown side-slips on the final approach, and the Cub just seemed to turn around and laugh. He was really sorry to have to put the Cub down and Pugh added that he now understood why the PA-18-A was so popular among crop-spraying pilots. Incidentally, the aircraft handles well on the ground, the rudder being connected by spring to the tailwheel and the brakes operated differentially by heel pedal to give good steering. One never runs out of control; one never seems to run out of anything in a Cub—except perhaps time to play with it.

Next, Murray said, would we mind if he did one circuit each with us in the Tri-Pacer, after which we were welcome to take it

away and go and find out all about it for ourselves. This friendly four-seater is remarkably refined and with the Piper AutoFlite automatic pilot, front and rear cabin heating, cigarette lighter *et al*, it fully justifies being classed among the world's better executive aeroplanes. As with the modern family motor car the Tri-Pacer is first of all a relatively inexpensive way of getting from place to place. It is good fun to fly yet not, perhaps, a first choice for flying just for fun. For example, the spring interconnection between ailerons and rudder can always be felt, and as a result the controls are a wee bit on the spongy side, while the aeroplane is really too stable to be particularly responsive.

Access to the cockpit is by a front door on the starboard side and a rear door to port with convenient footrests; the cockpit is very comfortable in the modern American manner, with sliding seats, a neat and sensible layout of all the controls and adequate ventilation. The days of dressing up to fly have now passed and not even headsets are required.

Master switch and starter button are hidden under the left front seat to prevent tampering and the "personalized" key is inserted in the rotary magneto switch with "off," "1," "2," and "both" positions. Circuit-breakers are grouped together on a panel hidden below the left-hand end of the instrument board.

Starting and taxying are too simple to require much description. You switch on, press the button, release the parking brake and taxi the aeroplane like a car on the steerable nosewheel. Cockpit checks are simple (they are written on the instrument panel) and the take-off is just a matter of opening the throttle and flying the aeroplane off the ground. The Tri-Pacer unsticks at about 65 m.p.h. and is climbed on full throttle at 80 m.p.h. at a pronounced nose-up angle.

At 3,500ft and 2,500 cruising r.p.m. on the 160 h.p. Lycoming, the Tri-Pacer cruises along at a steady 125 m.p.h., using up some seven gallons of petrol every hour. Although forward and downward visibility is good the leading edge of the wing severely blankets the view in even a moderate turn; the normal technique is to lift the wing before any change of direction is made.

The stall is absolutely innocuous. Pugh records that it occurs with very little warning and is manifested mainly by a high rate of sink. Flaps up and power off, the change from climb to sink—with no noticeable change of feel or attitude—occurs at 63 m.p.h. and with flaps down at 50 m.p.h. So high does the nose have to be pulled with any power on at all that an inadvertent stall is very unlikely; in any case it does not occur until the airspeed has fallen well below the minimum indication.

The best way of making an approach seems to be to motor in with just a little throttle and with the aeroplane in a nose-high attitude. In any case the nose lifts considerably as the flaps are lowered—rather unusually requiring that nose-down trim be applied on the approach. (Once again, Pugh grumbled about the low-geared trim handle.) The first movement of the flap lever increases the lift considerably but with full flap down the Tri-Pacer develops quite a substantial rate of descent and can be put down within a few yards of a chosen point without difficulty.

There is no great refinement about landing: one just drives down and applies brakes at once—it seems to be quite impossible to hold the nose up once the mainwheels have touched. Attempts at short landings are very rewarding indeed, but a little care is required to see that the rate of sink does not get out of hand. As Pugh found the first time he tried one, the Tri-Pacer will run out of elevator without much warning if speed is allowed to fall off without compensating throttle. The result can be a very positive short landing. A steady pull on the big brake lever will bring the Tri-Pacer to rest in 50 or 60 yards.

"Once we had seen the Comanche . . . we had eyes for very little else"

Lambert fully confirmed the Tri-Pacer's very useful ability to sink like a brick during an approach. Waiting at about 800ft until he thought he must overshoot a given touch-down point, he lowered flap and let the speed drop back to about 60 m.p.h. Nothing much happened for some seconds and then it really started downhill. A trickle of throttle at 50ft brought the round-out and more throttle was needed to reach the touch-down point. That 800ft just vanished; a particularly useful feature for relatively inexperienced pilots. The steeper an approach, the easier it is to arrive at a given point.

In order to check the effectiveness of the elevators in relation to the trimming tailplane Lambert trimmed the Tri-Pacer in a glide with full flap at 65 m.p.h.—corresponding to 1.3 V_{s1}—and then applied full throttle with hands off the control wheel. There was little swing, but a marked nose-up surge which took all but a fraction of forward wheel movement to hold in check. He tried this again at 80 m.p.h. and the control effectiveness was much better. In the sudden overshoot case, therefore, the Tri-Pacer is approaching control limits.

AutoFlite, with which the Tri-Pacer, Comanche and Apache can be fitted, is based on the Federal electric autopilot using modified horizon and D.I with pick-offs for attitude control and directional lock. When the heading lock (operated from the D.I.) is engaged the aircraft turns on to and holds the 360 deg heading. Turns of up to 179 deg can be selected in one step and Piper make a sales point of the "get-you-home" facility that this provides. A continuous orbit can be set up by caging the D.I. when offset by about 20 deg from 360 deg. AutoFlite will hold a course to ±5 deg.

Much as we enjoyed flying the Super Cub and the Tri-Pacer, there is no doubt that the highlight of our day was flying the Comanche 250. Once we had seen it nestling sleek and beautiful on the tarmac outside Tim Vigors' office we had eyes for very little else. Its lines are as modern and as flowing as a jet's.

There is a good deal more to the Comanche than there is to the Tri-Pacer or the Cub, but nothing that would intimidate even quite inexperienced private pilots and once again the cockpit check list is written up on the instrument panel. As soon as the Lycoming is started it settles down to tick over at an even 550 r.p.m. and the aeroplane is taxied in a silence that at first acquaintance is quite astonishing. Low noise-level is certainly one of this aeroplane's most endearing features; there is no doubt in our minds that this contributes very substantially to the ease and to the pleasure of operating it over long distances.

Certain features of the cockpit layout are particularly praiseworthy. The fuel selector, for example, is an L-shaped handle which thus indicates unequivocally the flow of fuel from one or other of the wing tanks to the engine or from a tank into an off position. A lever hanging down from under the panel is pulled back to apply both wheel-brakes, all steering being through the

Both authors were enthusiastic about the Comanche cockpit—seen here in 1960 form equipped with radio compass and Narco Omnigator. Controls along the lower edge of the panel are, left to right from the ignition switch: starter, parking brake, mixture, throttle, propeller, carb. heat, primer, AutoFlite, lighter, cabin heat, defroster and cabin vent. Below are the brake lever, flaps and rudder trim

THE PIED PIPERS . . .

rudder pedals, which are connected to the nosewheel only when the latter is extended. Flaps are lowered mechanically, and the undercarriage is normally operated from a switch, a white light shining whenever it is up or in transit and a green showing it down and locked. At the same time a stubby, telescopic red handle in the floor moves forward when the wheels are down, giving a further position indication. The electric motor operates a single screw-jack for all three wheels and, in case it fails, you put the operating switch to a central position to isolate the motor, rip out a small panel in the floor, and lower the complete gear with a single sweeping pull backwards and downwards on the telescopic lever. Complete instructions for this are clearly printed on the inside of the small floor-panel and (said Lambert) it looks as if one could do the job without getting oil on the hands. "Sissy," said Pugh.

In the Comanche, no flap is required for take-off and the procedure is to point the nose into wind and to open the throttle. The aircraft unsticks at about 65 m.p.h., rapidly accelerates to 95 m.p.h. and will then climb at no less than 1,500ft/min. Vigors told us that on the regular trips he and his associates make to Dublin he pushes in the AutoFlite as soon as he is off the ground, flies down the I.L.S. localizer to Birmingham, clears Customs, takes off again, picks up his Dublin V.O.R. radial, slides back the seat, lights a cigar and spends the next hour looking out of the window.

The visibility is, in fact, extremely good in every direction except immediately overhead and immediately below. The impression one gains is that the Comanche is just like a little airliner: very smooth and quiet, restful and comfortable, and it puts the ground behind it at an altogether satisfactory rate.

In straight and level flight with 23½in manifold pressure and 2,400 r.p.m. (set exactly by a vernier knob on the pitch-control plunger) the Comanche goes on accelerating for a surprisingly long time and until the A.S.I. is indicating 175 m.p.h. During this change of speed the harmonization of the controls changes somewhat, owing to the characteristics of the slab tailplane with its anti-balance tab. At low speeds the tailplane is extremely light—in fact, the lightest of all the surfaces—but as speeds increase it becomes gradually heavier. Lambert found that at cruising speed, control forces for something like a steep turn become very high, and Pugh added sagely that the stick forces per g—the loads in relation to the response achieved—had increased considerably.

At its cruising speed the Comanche is stable in all three axes: it is effectively damped in pitch, it is positively stable in yaw and exhibits just-positive stability in roll; after the application of 10 deg of bank it will very gradually return to straight and level flight.

If, when one is flying trimmed at 175 m.p.h., the wheel is pulled back to reduce speed by 10 m.p.h. the nose stays up until a further 20 m.p.h. are lost and then drops very slowly down for an increase to 185 m.p.h. The nose then comes up again to give 160 m.p.h. All this happens very slowly indeed and is followed by two or three more very small and slow phugoids. Lambert felt that the Comanche was perhaps a little difficult to trim hands-off. The ailerons are excellent by any standards; they remain crisp down to the stall, although at such speeds the rudder loses some of its effectiveness and directional control requires firm movements.

From the comparatively high cruising speed the stall takes a long time a-coming. With wheels and flaps up the stall-warning light starts to wink at 65 m.p.h., there is well defined aerodynamic buffet at 60, and at 58 m.p.h. it stalls straight with no wing drop. With the gear and flaps down the stall occurs at much lower speeds but aerodynamic warning is now almost non-existent. At 55 m.p.h. the red stall-warning light starts to flash quite slowly; as the speed drops the break-away occurs at about 50 m.p.h. There is a slight tendency for either wing to drop if the controls are held hard back but very little height is lost.

No great skill is required to land the Comanche satisfactorily. There is a sequence of landing checks to be made on the down-wind leg and the wheels can be lowered at up to 150 m.p.h. With gear and full flap down and power off, the Comanche descends at 1,100ft/min at 80 m.p.h., giving a very useful approach gradient.

During our day at Kidlington approaches were made through a very bumpy patch of air off the down-wind end of the landing runway and it was particularly noticeable that the Comanche rode the bumps with a much better damped motion than did its lighter sisters. The standard approach technique is to come in over the hedge at about 75 m.p.h. with a little power on and to close the throttle slowly during the round-out, at 65 m.p.h., where allowance must be made for the now very sensitive elevator. If the speed has been a little excessive the Comanche will float but otherwise it rolls gently on to the ground. The undercarriage legs are very short and the tyres are fat so that the Comanche is perfectly happy on rough grass. Sharp bumps or heavy landings are excellently absorbed. (Who found that one out?—Ed.) The brake lever can be heaved back hard after touch-down.

In retrospect, we both feel that this would be our first choice as a personal or business aircraft and respectively nearly missed our lunch (Lambert) and tea (Pugh) going round and round to try it just once more. We both want very much to fly it again, so we hope that next time the editor won't send us together; we might fall out over who should fly first. But then, that was where we came in.

* * *

The data below apply to the 1960 series Pipers. Apart from the models listed, the range now includes the PA-18-A (agricultural version of the Super Cub 150); Super Cub 95; Caribbean (as Tri-Pacer but with 150 h.p. Lycoming); Tri-Pacer 160; Comanche 180 and Comanche 250; Pawnee and the Apache and Aztec twins. Vigors Aviation are British agents for all aircraft in the series and hold at Kidlington and Dublin spares for the Super Cub, PA-18-A, Tri-Pacer, Apache and Comanche to the value of about £12,000. Some used aircraft are also to be imported in order to establish a supporting second-hand market. New prices were given in *Flight* for October 2, 1959. Most of the Piper types can be supplied with Collins, Lear or Narco radio, for which Vigors have spares available.

This is our favourite outside view of the Comanche

	Super Cub 150	Tri-Pacer 160	Comanche 250
Powerplant	Lycoming O-320	Lycoming O-320-B	Lycoming O-540
Span	35ft 3½in	29ft 3½in	36ft
Length	22ft 6in	20ft 7in	24ft 11in
Height	6ft 8½in	8ft 4in	7ft 3½in
Gross weight (lb) ...	1,750	2,000	2,800
Useful load (lb) ...	820	890	1,600
Baggage capacity (lb)...	50	100	200
Fuel capacity (Imp. gal)	30	30+7 opt	50
Cruise at 75 per cent power (m.p.h.) ...	115	134	181
Corres. fuel consumption (Imp. gal/hr)	7½	7½	11½

Not the Comanche's most elegant viewpoint but one that gives an interesting indication of the wrapped skins covering the wing and of the undercarriage in its stowed position

SIGNALS COMMAND

A Unique Formation: Latest of the R.A.F. Commands

"FLIGHT" PHOTOGRAPHS

A.V-M. Sir Leslie Dalton-Morris, K.B.E., C.B., the A.O.C-in-C. Signals Command, who before his present appointment was A.O.C. No. 90 (Signals) Group

ON the wall of an office in the headquarters of R.A.F. Signals Command at Medmenham, Bucks, hangs a painting called *The Visiting Corporal*. It is a melancholy 1914-18 War scene, the landscape dreary and lifeless with a background of shattered trees and muddy desolation. In the foreground a soldier trudges along carrying a small square box. He is on a round of units to check their communications, rudimentary as these were in those days; and the picture which immortalizes him is held in sentimental respect at Medmenham. For the lonely figure is the ancestor of all subsequent Service signals organizations, of which Signals Command is the latest, being just over twelve months old.

Its inauguration was marked by a dinner last December; and in his speech on that occasion the Air Officer Commanding-in-Chief, Air Vice-Marshal L. (now Sir Leslie) Dalton-Morris, proclaimed its originality when he said: "A separate Signals Command is unique in the Air Forces of the world, and indeed it has no counterpart in either of the other Services."

It was born, so to say, from wartime necessity; for until 1939 no exclusive signals organization existed. In pre-war days radar was in its infancy and world-wide radio telegraph services were just beginning to grow up, air-to-air and air-to-ground communications were rudimentary, and there were few radio aids to navigation. In such circumstances each Command was able to look after its own signals affairs, and these were co-ordinated by the Air Ministry.

Then in 1940 came a change. In that year No. 26 (Signals) Group was formed, primarily to handle the increased problems of world-wide telecommunications which a world war had thrust upon the R.A.F. In addition No. 60 Group formed within Fighter Command, to bring the radar stations on which Britain's air defence depended under R.A.F. control and administration; and because of some similarities of technique, the Group was also made responsible for Gee and Oboe, Bomber Command's principal wartime navigation and bombing aids. Radar counter-measures were controlled by two other signals formations: No. 80 Wing operated in close liaison with Fighter Command with the object of spoiling the enemy's bombing aids; and when Bomber Command took the offensive its aircraft were accompanied by those of No. 100 Group to deceive the German radio and radar defence services.

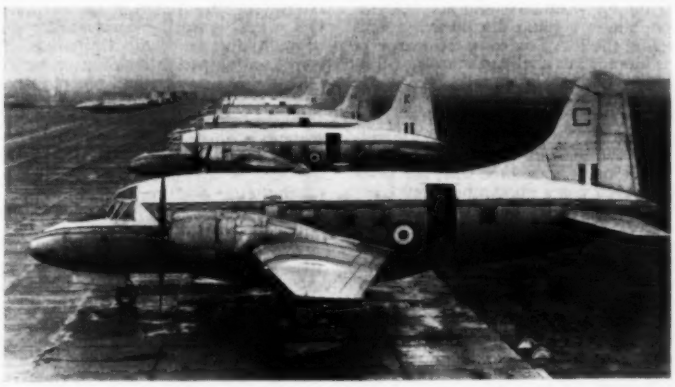
Immediately after the war No. 90 (Signals) Group was formed to take over the functions of all these wartime formations. It operated under that title for twelve years; then on November 3 last year, in recognition of the increasing part being played by electronic systems and technical personnel both in aircraft and unmanned weapons, it was granted Command status.

Marshal of the R.A.F. Sir Dermot Boyle, Chief of the Air Staff, defined this honour in complimentary terms at the inaugural dinner. "In a modern Air Force," he said, "we rely to a very great extent on electronic aids to enable us to accomplish our mission. In recognition of this fact, and because of the invaluable work which 90 Group has done over the last ten years, the Air Council has decided to grant to you the status of a Command. You now stand shoulder to shoulder with the operational Commands as part of a team. Under this new title we know that you will continue the sterling work for which you have become internationally famous."

The scope of this "sterling work" can be expressed briefly under four headings: radio engineering; electronic warfare; telecommunications; and the calibration and operation of navigational aids. In at least two of these matters flying is involved, and since the Command operates two airfields (at each of which there are two squadrons) it is by no means a purely ground-based formation.

To clothe these bare bones with descriptive flesh there can be no better authority than the Senior Air Staff Officer, Air Cdre. A. G. Powell. In his office at Medmenham the S.A.S.O. tells a quiet tale well, letting the large facts speak for themselves. Signals Command has some 38 stations and about 8,000 personnel. Its 38 bases include the airfields just mentioned, major transmitting and receiving stations, communication and switching centres, three Gee chains, four ground radio servicing squadrons, a large radio engineering unit and schools for advanced training in connection with radio warfare techniques.

One of the Command's most important functions is radio engineering. The C-in-C. is responsible to Air Ministry for the design, development and production (in small quantities) of ground radio systems and component parts used by the R.A.F. It also manufactures and develops special types of equipment for electronic warfare. But apart from special tasks in connection with radio warfare, airborne radio is normally outside the scope of Signals Command, Emphasis is upon ground radio engineering, which requires a division of work between civilian and Service personnel. Co-operation between Service and civilian engineers was particularly stressed by the S.A.S.O. He pointed out that Signals Command has design authority for a wide range of equipment built by industry as well as for its own developments. Problems arising from such equipment, as well as from third-line servicing, are the Command's responsibility. To assume this design authority, it has a number of civil servants who are high-grade professional engineers.



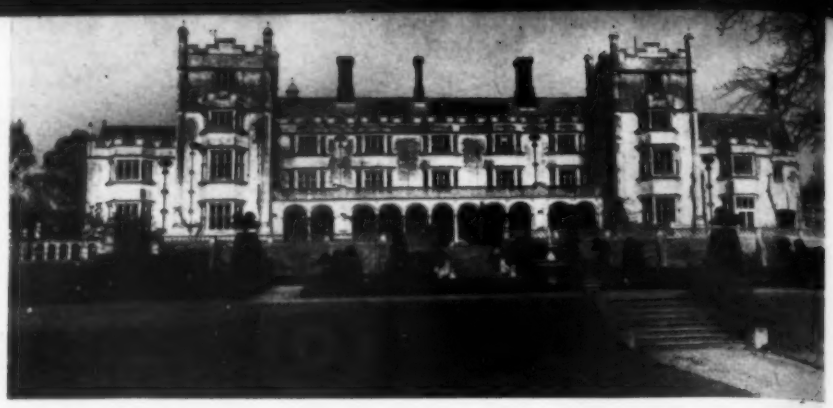
Varsities of No. 115 Sqn. and Canberras of No. 245 Sqn. (background) at Tangmere

The third sphere of Signals Command activity is the world-wide telecommunications system known as C.A.F.T.N. (Commonwealth Air Forces Telecommunications Network). The Command has functional control over the whole of the R.A.F. part of the Commonwealth Air Forces network, and direct control over U.K. stations. A worrying factor at present is the manpower situation when National Service comes to an end, because a high percentage of operators are N.S. men. One solution being adopted is increasing automation; and another is the replacement of outdated and worn-out equipment with its modern counterpart, to ease the servicing and repair problem. The Command is also responsible for the operation of the R.A.F. administrative telephone network, and acts in an advisory capacity to Commonwealth Air Forces on operating procedures and servicing.

Its fourth main task is the calibration and operation of navigational aids, which involves Tangmere. At this station are specialists in the calibration of radars and R.A.F. radio approach and navigational

A. Cdre. A. G. Powell, Senior Air Staff Officer, Signals Command

SIGNALS COMMAND . . .



"Its appearance is one of grey stateliness": Danesfield, now the Signals Command headquarters officers' mess at Medmenham

aids. Signals Command is also responsible for the operation and technical and administrative control of Gee systems in the U.K. In referring to its specialized knowledge of radar and other aids, the S.A.S.O. said that personnel on the Ground Radio Servicing Squadrons "must know well all the radio equipment used by the R.A.F."

He added that the G.R.S.S.s are "closely dovetailed into the operational Commands," so at the moment there was no question of civilianizing their personnel. In the G.R.S.S. field, the Command's main aim is to support the deterrent forces.

Similarly, all the Command's flying operations are carried out in support of its primary rôle, radio engineering. At Tangmere there are two squadrons, No. 115 (Varsities) and No. 245 (Canberras). The former is a radio calibration unit dealing with all approach and navigational aids used by the R.A.F. The Canberra squadron does high-level calibration of the air defence radars. This involves a daily "milk run" on weekdays (and at weekends on special occasions) with one aircraft going northwards round the U.K. and the other encircling the R.A.F. area of Germany.

Air Cdre. Powell said it was intended to civilianize the C. and R. part of the Canberra squadron's work. Its other tasks were to be given to No. 115 Sqn., which is to be established with jet aircraft.

Signals Command inherited from 90 Group a handsome house which is now the headquarters officers' mess and C-in-C.'s residence and close by which the headquarters offices are situated. Called Danesfield, it wears its Gothic appearance with the pride of a Jeffrey Farnol pastiche. It even has a ghost, the Grey Lady who in flowing robes walks the postman's path from the rifle range to the officers' mess courtyard. Danesfield was the creation of the soap millionaire, Robert Hudson, who in 1897 bought the original house of that name then built the existing mansion on a site about two hundred yards away.

Its appearance is one of grey stateliness, with a clock-tower and a courtyard to welcome visitors and a plethora of gardens for their delectation—seven in all, ranging from formal lawns to grottoes whose calculated naturalness would have delighted Pope. These gardens slope gradually away from the house to the cliff, which peers over the Thames at one of its loveliest corners.

Inside Danesfield all is much as one might expect in a residence built fifty years ago to resemble a Tudor stately home. There is abundant dark panelling, a minstrels' gallery, a library and a general air of everything trying to look much older than it really is.

R.A.F. occupation of Danesfield began in 1941, when it was requisitioned. It became the home first of the Central Interpretation Unit (later re-named the Allied Central Interpretation Unit) and then of the Joint Air Photographic Interpretation Centre. When No. 90 (Signals) Group was formed the house became its headquarters and later, after renovation, the officers' mess.

The Controller of R.A.F. Telecommunications, A. Cdre. A. T. Monks, by the map depicting the Commonwealth Air Forces' telecommunications

In the offices adjoining Danesfield are Signals Command's departmental heads, including the Controller, R.A.F. Telecommunications; S.O.A.; Wing Commander Tech. Plans and Progress; Inspector of Radio Services; Chief Radio Engineer and the Senior Technical Staff Officer.

The Controller. R.A.F. Telecommunications (A. Cdre. A. T. Monks), has functional control of all the major R.A.F. communication centres and maintains continuous liaison with his opposite numbers in the Commonwealth Air Forces. On his staff he has an Australian, a Canadian and an American, indicating the international character of R.A.F. signals traffic. (The Christmas Island detachment can be contacted either through the R.C.A.F. in Ottawa or the R.A.A.F. in Melbourne.) Another function of C.R.A.F.T. is setting standards for signals communication, either through directives, the *Craftsman* (journal of the C.A.F. network), continuation training or by personal visits of inspection.

In the Master Traffic Control Office at Medmenham, the Duty Traffic Controller has in front of him a large wall map of the world showing by means of red, orange, white and green lights the traffic situations on the R.A.F.'s global lines of communication. There is also a voluminous card index, kept in eighteen drawers which are said to contain half-a-million cards, providing a complete (background and current) routing guide for all signals traffic. Beyond the U.K. this is carried by radio, with Stanbridge as the main gateway station.

Signals Command, which acts upon the R.A.F. requirement to pass messages at any time day or night, uses the international teleprinter code for telegraph communications. It handles approximately 4m messages a year and the loss rate is said to be 0.002 per cent. It is now tackling the errors made by operators.

Communications networks require installations, and "planning and progressing" such installations is one of the tasks of the Wing Commander Tech. Plans and Progress. Equipment he deals with covers everything pertaining to Signals Command at U.K. airfields and in its overseas communications. His other main task is planning and progressing the installation of radio navigational and approach aids both at home and overseas.

There is a complicated procedure for carrying out Air Ministry radio engineering instructions, which may originate as an operational Command or Air Ministry requirement. The Director of Radio Engineering allots a priority category and issues a radio engineering instruction; then comes the first detailed planning as the requirement reaches Signals Command. This involves the issue of individual signals orders, allocation of priorities within the Command and estimation of completion dates; and includes matters of siting, provision of equipment and installation.

The wing commander's job touches liaison with other Commands, design work by the Chief Radio Engineer's staff at Medmenham, contact with manufacturers, calibration and trials. A pertinent example is Gan, where the installation of the main telecommunications centre and airfield aids means the provision of equipment and the manufacture of ancillary items, design and siting, and work done by the fitting party.

Not far away from the wing commander's office is that of the Inspector of Radio Services. His work ranges far afield, with a world-wide "parish" for his activities. Because of the variety and complexity of R.A.F. radio services it is essential that there should be some overall supervision and standardization. A staff officer at Air Ministry gets few opportunities during his three-year tour to visit units at home and abroad, or to assess the effectiveness and realism of directives issued by his department. So it is the primary function of the I.R.S. to maintain this link between Air Ministry and R.A.F. units in all parts of the world.

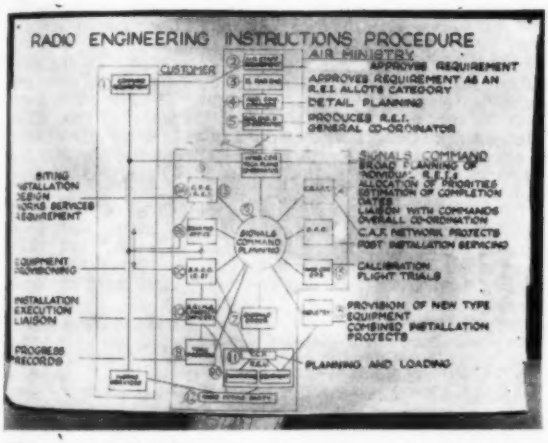
Responsibility for inspection has been placed on Signals Command, and the Inspector is directly responsible to the A.O.C-in-C. He has ready access to all the Signals Command staffs on day-to-day problems, and is within easy reach of Air Ministry signals and radio engineering staffs on matters of policy. The Inspector has a staff of three officers, each responsible for

some particular aspects of communications and radio engineering.

To carry out his touring duties and flight-checking A.T.C. communications the Inspector has first call on a Hastings C.2, WJ338, called *Iris III* (successor to *Iris I*, a Lancaster, and *Iris II*, another Hastings). On overseas tours the Hastings is also used for the transport not only of the Inspectorate team but of C.R.A.F.T. teams. *Iris III* carries a variety of radio equipment for its specialist function and is sometimes fitted with *ad hoc* equipment on which Air Ministry wishes the Inspector to make special reports or do Service trials. Trips to the Middle East take two to three weeks and those to the Far East five. The teams also visit Malta (which includes Idris) and Gibraltar and pay liaison visits to Commonwealth Air Forces. Commands overseas are visited once a year, and those at home once every 18 months. At home, a full day is usually spent at each of a number of selected stations.

The I.R.S. is concerned with existing facilities; the Chief Radio Engineer's prime task is the provision of new ones. In the design aspect of this work there is a considerable civilian element, some 200 being employed within the Command, including professional engineers, technicians and draughtsmen. At their head is Mr. E. Potts, who explained that the type of engineering done is mostly on installation designs. If a particular "black box" is necessary, or when ancillary equipment is required, it is designed; equipment is adapted for R.A.F. usage, and the Civilian Technical Branch is ready to supply consultative advice on any aspect of ground radio. With civilian staff there are no postings and thus there is an unbroken chain of experience.

A typical task just completed is the reorganization of the U.K.



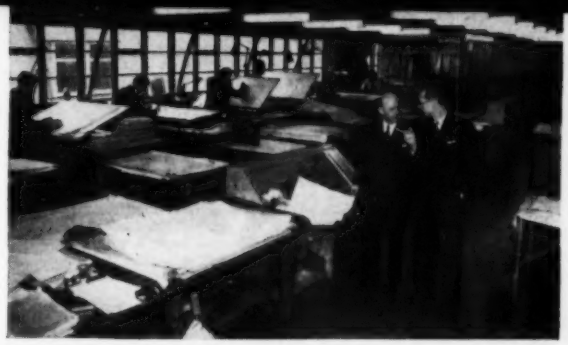
"There is a complicated procedure for carrying out Air Ministry radio engineering instructions": a chart which describes it pictorially

Gee Chain. This was brought about by the need to change the geographical cover afforded by the system and, at the same time, the opportunity was taken to modernize the equipment and aerial systems. Since the "cover" was being changed it was necessary to change the functions of some of the existing stations; "masters" became "slaves" and higher masts were erected. Some of these proposals brought the Command into conflict with the C.P.R.E. due to the fact that high towers were required in some local beauty spots, and extended discussions preceded the grant of authority.

Much design work was being done in connection with the installation of some fifty Instrument Landing Systems, which involves siting localizers to give azimuth information, glide path systems and marker beacons. Another big project is the conversion of air/ground communications, including some navigational aid systems such as D/F, from the V.H.F. band to U.H.F. The design work of the Civilian Technical Branch requires a large force of draughtsmen, and there are fifty at headquarters.

Mr. Potts commented that in developing new systems of world-wide signalling they were always looking for ways of reducing errors, and were hoping to introduce systems to achieve this.

A good idea of the scope of Signals Command activities can be gained by a look at the work of the S.T.S.O., who has a similar kind of responsibility to his counterpart in other Commands, covering all types of engineering equipment. Several types of aircraft are in use; M.T. includes radar convoys; there is a certain amount of general engineering; very little responsibility for armament (unlike the operational Commands) but full responsibility for the Command's radio equipment on its own stations; third-line servicing of radio equipment in other Commands, and a certain amount of fourth-line on equipment in this country and Germany, special equipment at home and overseas, and radio engineering installation.



Mr. E. Potts, the chief radio engineer (in dark suit), and Mr. J. H. Scares, the chief draughtsman, discussing a design in the drawing office at Signals Command headquarters

The S.T.S.O. has four staff departments to carry out the detailed work, headed by the Command Engineer Officer, Senior Servicing Officer and Senior Radio Installation and Manufacture Officer and Command Aeronautical Inspection Officer.

The Command Engineering Officer has more detailed jurisdiction over its aircraft (Comets, Canberras, Lincolns, Varsities, Hastings, Meteor), its M.T. (both load-carrying and R.V.T.) and outside aerial arrays, for example the air defence radars.

Three responsibilities fall to the lot of the Senior Servicing Officer: installation and maintenance of airborne radio equipment for all Command aircraft; third-line servicing of all ground radio equipment, involving the "fire service" which ensures that defective equipment installed at operational stations is back "on the air" within twenty-four hours (there are four ground radio servicing squadrons—at Norton, near Sheffield, Kinloss, Tangmere and Chigwell—each with its own "operational area"), and compilation of a proportion of the servicing instructions on all types of ground radio equipment. Notice is given by Air Ministry twelve months in advance of the introduction of new equipment and compilation involves liaison with makers and ministries.

S.R.I.M.O. (Senior Radio Installation and Manufacture Officer) has responsibilities covering almost every piece of ground radio equipment in the R.A.F. About 85 per cent of R.A.F. signals equipment is made by contractors; the rest is produced at Henlow. In addition Signals Command can now order from Royal Ordnance Factories up to £10,000-worth a year.

The Command is itself a contractor, in respect of the other Services, this work coming under the aegis of S.R.I.M.O. It has installed TACAN for the Royal Navy, and there is liaison between Signals Command and the R.N. signals centre H.M.S. *Aeriel*. On behalf of the Air Ministry the Command is responsible for radio installation design for ocean weather ships, the initial fit being done by the dockyard concerned and subsequent servicing by the G.R.S. squadrons.

After an impression at headquarters level of the scope of Signals Command work, a metaphorical tour of typical units should complete the picture. These are the Central Signals Centre, Stanbridge; Radio Engineering Unit, Henlow; R.A.F. Edlesborough, one of the two main transmitting stations; Barkway, master station, Eastern gee chain; and R.A.F. Tangmere.

Stanbridge, near Leighton Buzzard, is the R.A.F. central signals traffic relay point and also houses its main telephone exchange. When the R.A.F. sited a station there in 1937 the site was not selected arbitrarily but pre-determined by its being a G.P.O. focal point for telephone cables.

Two R.A.F. wireless receiving stations, Chicksands and Stoke Hammond, and two transmitting stations, Edlesborough and Greatworth, feed into Stanbridge through landlines. Commander of the Central Signals Area is G/C. A. F. Ward, who is also C.O. at Stanbridge. The station deals with 10,000 messages a day, proportionate totals being about 5,500 internal and 4,500 overseas.

Visitors to Stanbridge, which apart from its aerial farm looks much like any other non-flying R.A.F. station, probably see first the circuit control section. This is the heart of the signals centre and its switchboard shows all incoming and outgoing circuits, but there is no complex plugging-in as with telephone switchboards.

There are normally no "straps"—i.e., connections—on the boards unless engineering work is taking place. The efficiency of a system that is not entirely automatic depends largely on the manning level and as 50 per cent of the operators are National Servicemen the system will be hard hit by the ending of compulsory service. However, it is envisaged that this loss of manpower will be counteracted by the higher standard of skill that can be developed in regular personnel, and later its effect nullified by the introduction of an entirely automatic traffic handling system on both line and radio circuits.

There is a great deal of co-operation at Stanbridge between the R.A.F. and the G.P.O. The R.A.F. uses G.P.O. landlines; the G.P.O. maintains the centre's filter, channelling and terminal equipment; and about forty G.P.O. engineers work at the station.

(*To be continued*) H. W.

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Take-off Monitors

WITH reference to Mr. Warner's letter on the subject of take-off control systems in your issue of October 23, I am not a pilot myself, but I may be able to offer a reason why his system cannot be practically applied in its present form to the bigger aeroplanes now coming into service.

He appears to make the assumption that an aircraft should normally reach flying speed with enough runway remaining to stop the aeroplane if take-off is abandoned at that point. However desirable this assumption may be, it is just not true of the high-performance aircraft of today. When Mr. Krushchev left America in his Tu-114 recently, it became airborne after covering 8,750ft of a 9,000ft runway (*Aviation Week*, recently). If Mr. Warner will station himself on the South-West Road near Hatton Cross when there is a light easterly breeze blowing, he can watch Boeing 707s lifting off from L.A.P. with less than 1,000ft of the almost 10,000ft-long runway remaining. Since these aircraft weigh upwards of 250,000 lb and are travelling at speeds approaching 200 m.p.h. at the time of becoming airborne, the only hope of stopping them (apart from crash barriers) would be to supply another 10,000ft of runway on which to decelerate.

Given runways twice as long as at present, Mr. Warner's scheme would be workable, but very rarely called into action.

If a take-off control is to be used, and if the take-off in the given conditions of weather for a given condition of aircraft is to be successful, the control must be such that it tells the pilot from second to second whether or not his aircraft is performing as it must. Such a system should therefore compare air speed with distance gone and give a straight "go" or "no go" indication to the pilot from the start of his take-off roll to "decision" speed. This decision speed will certainly be well below flying speed.

Stanwell, Middx. JOHN A. KENDAL.

Or "Ships," of Course

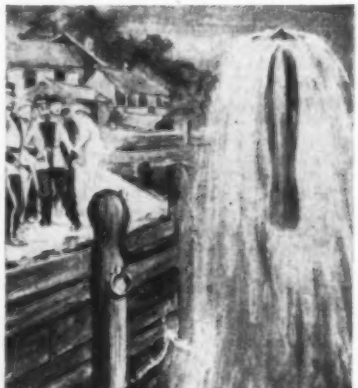
WITH reference to your article in the issue October 23 (centre column), can you please tell me what are "airplanes"? Are they perhaps some kind of power-assisted carpenter's tools?

Enfield, Mddx. B. DOWNHAM.

[Roger Bacon comments: "Airplane" is American (and, I regret to say, *Daily Express*) for the English word "aeroplane." I was quoting from the American, and I could not have presumed to translate.—Ed.]

Polaris Prototype ?

YOUR publication some weeks ago of a picture from a Jules Verne book showing what was considered to be the first representation of an artificial Earth satellite prompts me to send along this illustration of what may well have been the first idea of a submarine - launched missile. It is taken from a boy's book—*The Rival Submarines*, by Percy F. Westerman — published, apparently, before the First World War. The following lines from the story are explanatory:—



"'Man the aerial torpedo tube, Mr. Kenwyn,' ordered the captain. 'Give them a sixteen pounds charge.'

"With a whizz and a roar the projectile leapt through the water and soared four hundred feet in the air. There it burst, the concussion shaking every miserable hovel in Marromea to its foundations."

As the picture shows, the missile had a propeller, but I should add that the submarine also carried ". . . a deterrent . . . in the form of a powerful rocket."

London, W.1. D. SMITH.

"Sales Talk"—by a Journalist

RECENTLY I came across an article written by Mr. W. Deswarte, Director-General of Sabena (*Mach Magazine* of May 15, 1959), in which he stated that the cockpit of the Boeing 707 had only 180 instruments compared with about 500 of the Douglas DC-7C.

I asked a K.L.M. pilot about it, who is a DC-7C captain and one of the first K.L.M. pilots to fly the DC-8. He made it clear how wrong Mr. Deswarte is. We compared both the operation manuals of the DC-7C and the DC-8 to find out that in fact the DC-8 has more instruments than the DC-7C. Some of the instruments in the DC-8 which are new include the Machmeter, Doppler, D.M.E., stall warner, overspeed warner, etc. The DC-8 has 20 engine instruments against 16 in the DC-7C. It must be said that in the piston-engined aircraft the engine instruments are used to settle the engine performance, while in the jets they are only used for checking. The panel of the electric system in the DC-8 shows 12 instruments, compared with six on the DC-7C. There are many extra switches, too. Extra instruments in the DC-8 include those for hydraulic oil temperature, pressure cabin, etc.

"It is an old story which says that cockpits of jets are much more simple than those of piston-engined aircraft—these stories are made all over the world by journalists like you," said the K.L.M. captain, adding, "It simply is not true."

You have to make a big difference between what we call "sales talk" and "engineering." In the U.S.A. this is a common idea. Sales-people tell you the most beautiful things about an aircraft, but pilots always want the story from the engineering people, and that story is quite different. Recently I had a talk in Germany with Friedrich Seekatz, a director of Heinkel and the man who for more than 30 years was Fokker's sales manager. Talking about aircraft performance, he told me: "There are five different performances given by aircraft constructors. The first performance with the very first talk, the second performance with the official offer, the third performance by the signing of the contract (which is already lower), the fourth by the delivery, and the fifth performance (which is the real performance) to show the buyer what he has actually bought."

I think it is a pity that we aviation journalists receive daily the news-releases and beautiful brochures from aircraft factories all over the world, which are made up from "sales talk." We publish them in our articles and no wonder that many experienced pilots, reading those articles, are laughing "what those crazy air correspondents are writing about . . ."

Maarn, Holland. HUGO HOOFTMAN.

Geographical Ilyushin

"ALMA-ATA, a major resort on the Black Sea shore . . ." (from a reference, on page 405 of your October 16 issue, to the first route served by the Ilyushin Il-18).

How did *this* escape into black-and-white? Now try covering up by telling us that it's an American-style college, inaugurated outside Batum in a burst of post-tour Khrushchevist zeal, and that "Mater" was inadvertently beheaded in the Aeroflot handout—I know *that* one!

Please reposition Alma Ata where it was, 1,600 miles east of where you put it.

London, N.W.9. DESMOND McDADE.

FORTHCOMING EVENTS

Nov. 13. R.Ae.S. Agricultural Aviation Group: Discussion on the Cranfield Conference.
Nov. 17. R.Ae.S.: "Magnetogasdynamics," by J. A. Shercliff.
Nov. 17-18. Institute of Aeronautical Sciences: National Turbine Powered Air Transportation Meeting, San Francisco.
Nov. 18. G.A.P.A.N.: Annual Service (St. Michaels, Cornhill) and a.g.m. (Innholder's Hall, College Street, London, E.C.4).
Nov. 19. R.Ae.S.: Fifteenth British Commonwealth Lecture, "Air Survey and Newly Developed Territories," by W. P. Smith.
Nov. 20. R.Ae.S. Graduates' and Students' Section: Winter Dance.
Nov. 20. Institute of Navigation: "Radiometry, Radio-Astronomy and Infra-red Techniques," by C. M. Cade.
Nov. 24. Institute of Transport (West Middlesex Group): "Economics of Long Haul Air Transport," by J. B. Scott.
Nov. 24. R.Ae.S.: "Heat and Mass Transfer in Aeronautical Engineering," by Professor D. B. Spalding.
Nov. 25. Air Public Relations Association: Annual Reunion.
Nov. 25. Society of Environmental Engineers: "Investigation of Jet-induced Vibration," by M. O'B. W. Wolfe.
Nov. 25. Kronfeld Club: "The BEAline entry in the *Daily Mail* Race," by Peter Brooks.
Nov. 26. R.Ae.S. Third Lanchester Memorial Lecture, "Boundary Layer Research in the last Thirty Years," by Professor Dr. H. Schlichting.

R.Ae.S. Branch Fixtures (to Nov. 20): Nov. 16, *Henlow*, "Flight Development of a Modern Prototype Aircraft," by C. F. Bethwaite. Nov. 17, *Christchurch*, Lecture by Maurice Brennan. Nov. 18, *Preston*, "Aircraft Production Techniques," by L. G. Burnard; *Southampton*, "Supersonic Propulsion," by Dr. R. R. Jamison; *Weybridge*, "Flight Testing at Supersonic Speeds," by W/C. R. P. Beamont. Nov. 20, *Luton*, annual dinner.

Sport and Business

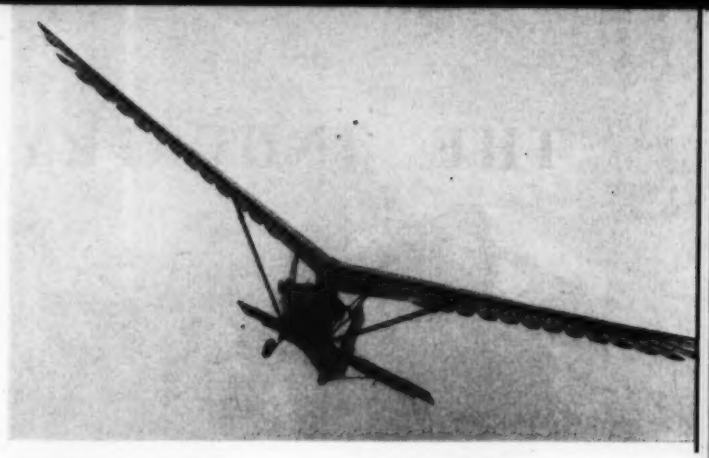
A HIGH STANDARD was maintained in the Kronfeld Club's second exhibition of paintings and drawings, held at the club during November 2-11. A total of 18 amateur and 14 professional pictures were displayed, and the competition for the amateurs was won by Mrs. Ann Welch with *Summer, '59*, one of several paintings which she had entered in the exhibition. Had *Flight* and not Michael Turner been the judge, Mrs. Welch would still have won first prize, but the picture would have been *A Red Glider*, a beautifully relaxed and spacious impression of Nick Goodhart's Skylark 3 circling in a summer-blue sky. Second, third and fourth awards went to John Blake, *Loss of Coastal Airship C.27;* Yvonne Middleton, *Last Flight;* and V. H. Veevers, *Silent Flight*. The judge's comments on the winning picture were "Excellent cloud study; well-composed and executed; good fresh colours; nice airy feeling"; and, on the runner-up, "Very good composition; first-class colour and true values. Technique competent but a little photographic."

Guest of honour at the club's annual dinner on Friday, November 6, was A. Cdre. G. J. C. Paul, secretary-general of the Air League. The health of the guests was proposed by Maurice Imray (a member of the Kronfeld Club and aviation secretary of the Royal Aero Club); the reply was by A. Cdre. Paul and the final speaker was Hugo Trotter, secretary of the Kronfeld Club.

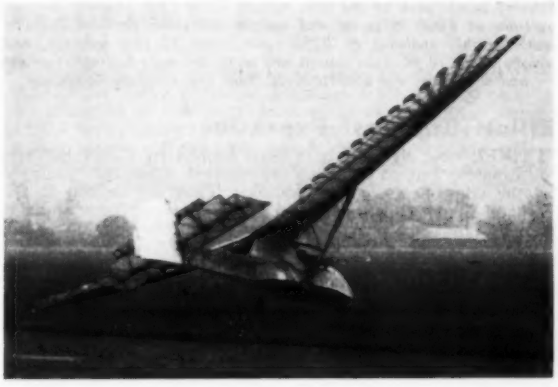
INCREASED MEMBERSHIP of Yorkshire Gliding Club was reported by club secretary Christopher Riddell at the annual general meeting at Sutton Bank on October 31. The club has an active fleet of six aircraft, and the year just ended has proved one of the most successful in the club's history. Officials elected included F. N. Slingsby, president; J. C. Reussner, chairman; J. White, secretary; and A. D. Hill, treasurer.

BEECHCRAFT DEBONAIR is the name chosen for the company's new single-engined Model 33. This choice is explained in a news release as follows: "The word derives from the French 'de bonne air'—its origin dating back to medieval France when sportsmen worked hard to develop valuable hunting hawks. In speaking of an exceptional bird, the proud owner would call it 'de bonne aire,' which means to be 'of good air.' Like the noble falcons of long ago, the new Beechcraft 33 Debonair's excellent flying and handling qualities merit the description 'of good air' . . ."

Mike Reilly and Malcolm Morris (just visible below Reilly's right elbow), on their way down to earth from a Rapide. Reilly, recently appointed successor to Dumbo Willans as chairman of the Royal Aero Club's parachuting committee, is an instructor with the Stapleford-based Ripcord Club. Another member of the Ripcord Club, Barry Griffiths, took the photograph



Flight testing of Emiel Hartman's manpowered ornithopter began at Cranfield on Sunday, November 1, with non-flapping towed runs behind a car along a runway. On Wednesday, November 4, when these photographs were taken, Hartman made a heavy landing and ground-looped off the runway after releasing from tow at a height of about 30ft. He had experienced control difficulties in a 7 m.p.h. crosswind



RECENTLY FORMED GLIDING CLUBS include the Norfolk Gliding Club at Tibenham airfield, 15 miles south of Norwich, and two R.A.F. G.S.A. groups at Driffield and Hornchurch. Other news from the British Gliding Association is that it is hoped to follow the recent advanced instructors' course at Nympsfield by a number of similar courses next year.

FOLLOWING THE SUCCESS of this year's National Gliding School organized by the Gliding Federation of Australia, a more ambitious course is being planned for 1960. The cost of this year's event, which received financial assistance from the Commonwealth Government, was £1,200: next year's course is expected to cost about £2,000. At Parafield, South Australia, a new 15-metre version of the Kookaburra glider, produced by Edmund Schneider Ltd., has been test-flown.

RETROSPECT

From "Flight" of November 13, 1909

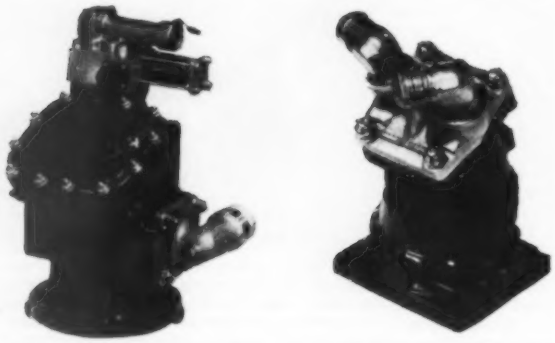
Kite-Flying Association (*27, Victory Road, Wimbledon*): An exhibition of kite flying will be held on Wimbledon Common on Saturday afternoon, November 20 (weather permitting), to give a practical demonstration of the two uses to which kites can be put during military or scouting operations. This demonstration has been specially arranged for the benefit of the Scoutmasters and boys of the Boy Scouts.

Scoutmaster F. T. Pringuer will show his method of signalling by the Morse code, with the aid of a kite. The device which will be used is his own idea, and should prove of great use to scouts during field operations.

W. Jones, of Gamage's Ltd., will show the Gamage Patent Camera apparatus, by which means very little skill is required, and the actual exposure (which is instantaneous) being quite automatic.

The hon. secretary will be pleased to receive applications for membership, and trusts that those interested in the Boy Scouts will send donations towards a prize fund for future competitions for the lads.

THE INDUSTRY



Hydraulic units designed by Vickers Inc. of Detroit and manufactured here under licence by the Sperry Gyroscope Co. Ltd. have been chosen by Vickers-Armstrongs (Aircraft) Ltd. for their VC.10s. The variable-delivery pump, seen on the left, runs at 2,750 r.p.m., passes 15 Imp. gal/min at 3,000 lb/sq in, and weighs approximately 16.5 lb. The motor (right) operates at 3,250 r.p.m., uses 12 Imp gal/min, and weighs about 10 lb. Four pumps will serve the main hydraulic system and six motors will operate slats, flaps and tailplane incidence

Elliott Brothers' Expansion

THREE new divisions have been formed by Elliott Brothers (London) Ltd. to carry out the business at present conducted by the company's aviation division. They are located at the Airport Works, Rochester, and involve several new appointments. The manager of the Aircraft Controls Division is Mr. W. H. Alexander, B.Sc., A.Inst.P., and there are three subsidiary managerships: civil autopilots, Mr. R. W. Howard, B.E. (Adelaide); military autopilots, Mr. H. Cook, A.F.R.Ae.S.; aircraft instruments, Mr. F. J. Pacey, A.M.I.E.E., A.F.R.Ae.S. The manager of the Servicing Division is Mr. F. J. Shields; and of the Aircraft Engine Instruments Division, Mr. A. N. Haskett.

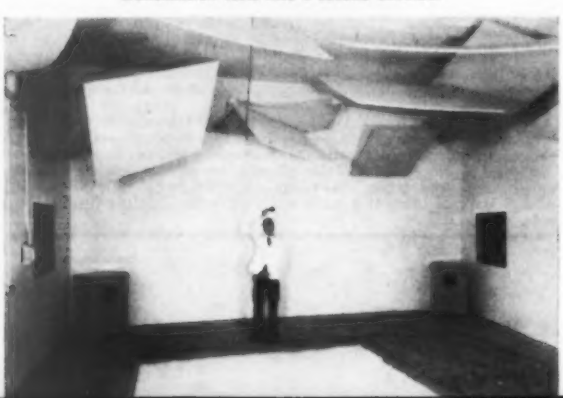
Another new appointment with Elliott Brothers (London) Ltd. is that of Mr. P. A. Hearne, D.C.Ae., D.L.C., A.F.R.Ae.S., who becomes manager of the Guided Weapons Division. He was formerly with the British Oxygen Co. Ltd. Moving from Sheffield to Rochester, Mr. Jeffrey Blake has been appointed sales manager of the Servo Components Division of Elliott Brothers, having previously been with Land Pyrometers Ltd.

Complete Acoustic Laboratory

NOW operating at Hemel Hempstead, Herts, is the comprehensive new acoustical laboratory of the Acoustical Investigation and Research Organization Ltd., whose head office is at 118 Cromwell Road, London, S.W.7. Airo Ltd. (to use the organization's short title) is stated to be the first independent, non-trading body to be formed in Britain for practical investigation and research into all aspects of noise problems and maintains close liaison with N.P.L. and the Building Research Station. It is fully equipped with resonant and anechoic chambers, fan tunnels and an underground sound tunnel to make all kinds of measurements on structures and equipment. Sections of wall, floor and ceiling, machinery, air-conditioning and electronic equipment can be installed in the test areas, and the organization issues a standard form of report on materials tested. General fields covered will include measurement of sound absorption, sound transmission and sound insulation, noise characteristics of machines, vibration and electro-acoustics.

Airo (who are part of the Hall Thermotank Group) are consultants to the P. and O. line for all soundproofing in their new liner *Canberra* and are undertaking work on aircraft interior and exterior noise and on noise characteristics of both testing and operation in connection with missiles.

A reverberant chamber in the new Airo acoustical laboratory. The reflecting panels are suspended in a random pattern from the ceiling. Sample structures can replace the partition at left for sound-transmission tests into a second chamber



Radomes for Valiants

FROM the Expanded Rubber Co. Ltd., of Mitcham Road, Croydon, Surrey, comes a note on the use of expanded nitrile Onazote—which has particularly good dielectric characteristics—for the nose radome of the Vickers Valiant. Double sandwich construction is employed, consisting of skins of finely woven glasscloth impregnated with a polyester resin and two ¼in-thick cores of expanded nitrile Onazote separated by several layers of glasscloth. The resin acts additionally as an adhesive between the glasscloth and the Onazote. Before lamination, the various layers are moulded to the required double curvature by heat and pressure.

These radomes are being manufactured by Thermo Plastics Ltd., of Dunstable, Beds, for Vickers-Armstrongs (Aircraft) Ltd.

IN BRIEF

Southern Instruments Ltd. are this month taking their new mobile demonstration unit on its first journey, a tour of Scotland arranged in co-operation with the company's Scottish agents, Elesco Electronics Ltd.

From November 23 the production of inflatable equipment at present carried out at the Elliott Equipment Ltd. factory at Llwynypia, South Wales, will be transferred to Slough, where the company's address is 5 Falmouth Road, Trading Estate, Slough, Bucks.

Marconi Instruments Ltd. have been awarded a further large contract, for telecommunication measurement equipment, by the Canadian Department of Defence Production. The order is for 124 A.M. signal generators, Type TF801D, to be used by the R.C.A.F. in the maintenance of ground-to-air V.H.F. equipment.

Mr. I. W. Readman has been appointed aircraft production manager at the King's Norton, Birmingham, factory of the Triplex Safety Glass Co. Ltd. This is a new post, "reflecting both the increased output of aircraft glasses, including gold-film anti-ice and mist windscreens, and growing production complexities brought about by the speed of jet aircraft."

This 15ft display model of a Boeing 707 is one of a number of this type of aircraft constructed for various airlines by Westway Models Ltd., of 178 Brent Crescent, London, N.W.10. Interior detail is complete with seats, "passengers" and lighting

Mr. J. C. G. Wegerif, who during the war acted as production director for Dowty Equipment Ltd., is with the agreement of the Bentley Engineering Group to give some of his time to Dowty Group production policy and has accordingly been appointed a Dowty director. The Dowty Group also announce that the service department of British Messier Ltd. has been transferred to Dowty Equipment Ltd. The manager of this new Dowty department is Mr. W. Spires.

The D.H. Sea Vixen and Folland Gnat will be the first British production aircraft to be fitted with liquid oxygen breathing systems as standard equipment. A number of sets were recently ordered by the Ministry of Supply from British Oxygen Aro Equipment Ltd. following the placing of a development contract with the company. The liquid oxygen system makes use of special vacuum insulated vessels, known as converters, which store the oxygen in the aircraft as liquid under low pressure and change it to gaseous oxygen when required. Development of this equipment has been hastened by the close association between British Oxygen and the Aro Equipment Corporation of Bryan, Ohio.

Among the projects being studied at the Langley Research Centre of the National Aeronautics and Space Administration are these six-engined transports. The design on the left is a one-fifteenth-scale canard with short-field characteristics; raised extensions on the exhaust deflect the jet efflux upward against the underside of the wing and over the lowered flaps. The other model, which incorporates area rule, is designed for speeds of between Mach 2 and Mach 3. Drag-reducing features are the six trailing-edge-mounted engine nacelles and two "Whitcomb bumps" near the wing tips. Both models form part of the transport-study programme at Langley Field

AIR COMMERCE

NEW FIELDS FOR THE TWIN PIONEER

SPECIAL dispensation has been granted to operators of Twin Pioneers permitting them to use "small airfields" with runways substantially shorter than those required by the scheduled field length regulations. Permissible runway length may in some circumstances be reduced by over 600ft.

The new conditions follow negotiations between Scottish Aviation, the Air Registration Board and M.T.C.A., and the approval of the last named has now been given for the Twin Pioneer to use "short field lengths." The manufacturers say that "these special conditions may be of interest to all operators, particularly those who are attempting to open up new routes."

Normally, such short fields could not be used by aircraft certificated to comply with Group "C" and "D" of British aircraft performance requirements, but the A.R.B. say that "they are satisfied that the characteristics of the Twin Pioneer permit its operation from appreciably shorter airfields with a relatively small reduction in the level of safety. Such operations will be justified . . . in under-developed territories where provision of air transport, where none existed before, is of special benefit to the community, or where the size of airfields is restricted by reasons of terrain."

The use of these shorter airfields is governed by a number of special limitations, among them 1,000ft ceiling and one mile visibility; an approach "substantially free from obstacles"; a firm runway surface; and with the aircraft flown by pilots with special training, including three take-offs from the actual strip. The new take-off field length is the take-off run required at take-off weight as scheduled in the flight manual with flaps at 14½ deg. Calculation of the *short* take-off field length at I.S.A., sea level and 14,000 lb gross weight, and at 1.15× the take-off run to take-off safety speed gives a distance of 1,075ft. The landing field length is the same. By contrast, the take-off run calculated to the normal Group D *scheduled* field length is 1,420ft and landing field length is 1,680ft, so that the saving is 605ft. Similarly, at 3,000ft, I.S.A.+ 20 deg C and 13,000 lb gross weight, the saving is 536ft.

AIR SAFETY AT NICE

SOME 200 delegates and their wives, representing over 20 nations, met in Nice recently to discuss vital problems of air safety—thus emphasizing the oft-repeated words of Jerry Lederer (director of the Flight Safety Foundation) that air safety knows no national boundaries. Nevertheless, limitations of knowledge within national boundaries were apparent at this Twelfth International Air Safety Seminar—the first to be held on the Continent in the history of the F.S.F. (only one previous meeting has ever been held in Europe—at the College of Aeronautics, Cranfield).

Although it is hoped that the F.S.F. will ultimately make available many of the papers for publication, the proceedings were private to the participants—since the objects of the Seminar were "to discuss safety problems in an atmosphere of calm objectivity; to bring together professional people with kindred interests who might not otherwise have the opportunity to exchange ideas"; and to afford those participating "an opportunity to gain perspective."

"Participants," continued the definition of objectives, "are expected to reflect their latest thinking on aviation safety or new developments with which they are familiar—to suggest better definitions of safety problems. Emphasis is placed on an exchange of viewpoints so that participants come away from the seminar with a better appreciation of the problems that face the other man." Based on this last broad aim, the seminar was an undoubted success. As in so many international discussions, some of the most valuable results emerge outside the conference-room walls.

The main seminar was preceded by a special session of medical specialists, who discussed such topics as the correct age to retire pilots and the urgent need for routine autopsies on all accident casualties.

Topics dealt with in the main seminar included flight fatigue; accident investigation; research into operating problems; airline and manufacturers' safety organization; mid-air collisions and air traffic control; search, rescue and survival; airport operations; and experiences in the training, maintenance and operation of the Boeing 707 (see page 562).

At the seminar dinner Lord Balfour of Inchrye addressed the gathering as guest of honour and Mr. Walter Tye, chief technical officer of the Air Registration Board, received the F.S.F. Annual Air Safety Award in recognition of his services to the development of international airworthiness standards.

Speakers from the United Kingdom during the seminar provided not only some of the most vivid presentations but also some of the dullest. It is a matter for some regret that U.K. manufacturers who are active (or hope to be active) in civil aviation were poorly represented—or not represented at all. It is also surprising to find that not a single member of the U.K. Civil Aviation Accidents Branch attended despite the time allotted to aircraft accident investigation. Can it be that our manufacturers feel they have nothing to learn, or do they prefer to learn in more difficult ways? Air safety knows no boundaries.

APARTHEID AT THE AIRPORT

A SIERRA LEONE M.P. and a Uganda M.P. in transit Jan Smuts airport, Johannesburg, on their way to the Commonwealth Parliamentary Association conference in Australia were recently refused admission to the European restaurant and escorted to the non-European restaurant. This incident had international repercussions, and now apartheid is to be relaxed to provide no-colour-bar accommodation at the airport. Parties of racially mixed delegates to international conferences who need meals or beds while in transit will not have to be segregated and it is hoped that the new all-race facilities will be ready by next June.

A statement by the secretary for transport, Mr. D. J. Joubert, says: "While these passengers are in transit and have not come through our Customs barriers, we regard them as international and not subject to apartheid." A new wing is to be built on the north side of the terminal building for the overnight accommodation of transitting passengers, and will be available on a non-colour-bar basis. But this will not be complete until 1965 and meanwhile, temporary facilities are being prepared by altering the existing terminal building. It will handle the reception of inbound overborder passengers, and limited accommodation for in-transit white and non-white passengers will be located in the existing concourse.

AIR COMMERCE . . .

THE INDEPENDENTS 1958-59

LAST Wednesday, November 11, the British Independent Air Transport Association was due to hold its annual dinner, on which occasion a report of the year ended June 30 is published. Guest of honour was to be the new Minister of Aviation, Mr. Duncan Sandys, who was expected to refer to his Ministry's plans for the future expansion of the independents alongside, rather than as "associates" of, the Corporations. Here is a summary of the B.I.A.T.A. annual report.*

It is almost a tradition for B.I.A.T.A.'s annual reports to express dissatisfaction with the year under review. This year is no exception; and the president, Mr. Eric Rylands (Skyways), says that the results for the year ending June 30, 1959 are "certainly . . . unsatisfactory," and that the results "demonstrate quite clearly the urgent need for revisions" in Government policy.

The traffic statistics published in the report show that total traffic carried amounted to nearly 133½m load ton-miles, an increase of just over 10 per cent compared with 1957-58. The report acknowledges that the year under review was one marked by "a slight international arrest of progress," but B.I.A.T.A.'s expansion nonetheless appears to have been greater than that of either Corporation in 1958-59.

Breaking down the traffic summary further, it appears that scheduled services went up by 20 per cent, to a figure of nearly 30m load ton-miles, for an overall load factor of 64.1 per cent, a healthy increase over last year's load factor of 59.9. Freight ton-miles on scheduled services showed the biggest increase of any section of the independents' activities: the figure of just over 12.7m load ton-miles was 48 per cent higher than in 1957-58.

Charter and contract operations, which account for 77 per cent of B.I.A.T.A.'s traffic, were not so encouraging. Capacity ton-miles amounted to about 112m, an increase of only one per cent. It is this figure rather than load ton-miles which, as the report points out, is the truest reflection of the overall position in charter and contract operations.

A curious item in the traffic statistics is the figure for passenger-miles flown on trooping flights. This is shown to be about 420m, a four per cent increase on 1957-58—though the figure for that year appeared in last year's report as more than 729m. It was this figure which led to a comment in these pages that British troops must not only be very light in weight but must also be transported over very long hauls, and it is noteworthy that the 1957-58 figure has now been revised to about 402m.

It is indeed apparent that this year's statistics, though again entirely lacking in financial facts and figures, have been prepared with care, although a significant passage in the report can only be interpreted to mean that the statistics are not fully representative of B.I.A.T.A.'s operations: "This [shortfall in expansion] cannot be readily deduced from the statistical summaries of the traffic results achieved which deal with the overall position concerning *a number of companies and for a limited period of time*" [our italics].

It was to be expected that the independents would present their ideas for the future regulation of British air transport in this annual report, which appears at a time when the new Minister is examining this very question. But apart from a brief reference to B.I.A.T.A.'s excellent and long-urged case for a general operators' licence, the reader is disappointed. The president in essence confines his remarks to hoping "that aviation laws will shortly be revised as a whole" and that B.I.A.T.A. "await promised Government action."

THE INDEPENDENTS' PASSENGER TRAFFIC

The capacity produced on all operations increased in 1958-59 to 171 million capacity ton-miles, which is approximately 24 per cent of the total United Kingdom air transport effort. In terms of passenger traffic, 1,439,354 passengers were carried in the following categories of operations:—

General scheduled services ...	792,797 (55 per cent of total)
Inclusive tours	172,755 (12 per cent of total)
Charter and contract ...	331,717 (23 per cent of total)
Air trooping	142,085 (10 per cent of total)

The passenger-miles performed on these operations produced the following position:—

General scheduled services	189,068,000 (22 per cent of total)
Inclusive tours ...	116,076,000 (14 per cent of total)
Charter and contract	130,061,000 (15 per cent of total)
Air trooping ...	419,557,000 (49 per cent of total)

**Annual Report of the British Independent Air Transport Association. Published by B.I.A.T.A., 13 Portman Street, London, W.1.*

GHANA'S FIRST YEAR

IN its report on the first year of operations, Ghana Airways show a total deficit of £190,118. Statistics given in the report are extremely skimpy; no mention is made, for instance, of the airline's revenue, operating costs or capacity offered, although reference is made to a detailed budget for earlier in the year.

During initial domestic and regional operations (which began on October 1, 1958, when domestic services were taken over from West African Airways), aircraft were chartered from the manager and receiver of W.A.A.C. while Ghana Airways was awaiting delivery of its own fleet for domestic and regional services—two D.H. Herons and two DC-3s. This charter arrangement, comments Mr. James Mercer, the airline's chairman, was responsible for a loss of £40,000, but "now that operations are being carried out with Ghana Airways' own aircraft, it is anticipated that the cost of the national airline to the country will be almost halved."

On internal routes the fares are such that it would be impossible for the airline to break even and this contributed to the loss on internal and regional operations of £185,000. Another £15,000 went towards the payment of dividend.

Undoubtedly the Accra - London route was the airline's most successful; the airline's share of the pool revenue with B.O.A.C. (from whom its Britannias are chartered) exceeded costs during the first three months of operation by £10,500. "The Ghanaian," says the chairman, "is making far greater use of his local air services now that they are operated by a Ghana company, and the revenue from services provided to other operators is much higher than was originally estimated." All in all, Ghana is well pleased with its first year's efforts. They lost money, as indeed they expected, but the amount was marginally less than had been forecast.

This is the first picture of a complete Boeing 720, lightest and fastest of the 707 family. Certification is planned for April, after which this aircraft will be the first of 18 to be delivered to United

A new shape—and a distinctive one—at Hatfield last week was that of the de Havilland Canada Caribou, in England at the start of a European sales and demonstration tour

B.O.A.C.'S POLE VAULT

BY next Monday, November 16, B.O.A.C. must file with the Civil Aeronautics Board documentary evidence in support of its petition to operate on the 5,443 statute-mile route across the polar regions to Los Angeles. Formal application was made on November 5, the hearing will be on November 20 and the Corporation hope to start 707 services in the spring of 1961.

That B.O.A.C. should file so early an application when the right to operate already exists (by the Bermuda bilateral agreement) is an indication of the Corporation's "once bitten" shyness following the long delay in obtaining the C.A.B.'s approval of the trans-Pacific route from Hong Kong and Tokyo to San Francisco. So far, no objections have been filed by PanAm or T.W.A.—the established competitors on the route—nor are they expected.

A. CDRE. MANN RETIRES

RETIRING this month is A. Cdre. Mann, C.B., C.B.E., D.F.C., M.I.E.E., R.A.F. (Retd.), who relinquishes the Ministry post of Director-General of Navigational Services. He has been responsible for the development of the U.K. air traffic control system, telecommunications, fire service, technical development of airports and ground services. In a long career in aviation since the days in 1920 to 1924 when he gave his famous solo displays on Snipes, A. Cdre. Mann has served in the Middle East, in Africa and as S.A.S.O. of 26 Signals Group. He joined the M.T.C.A. as Senior Signals Officer and U.K. representative Middle East in 1945 and was appointed D.G.N.S. in January 1950.

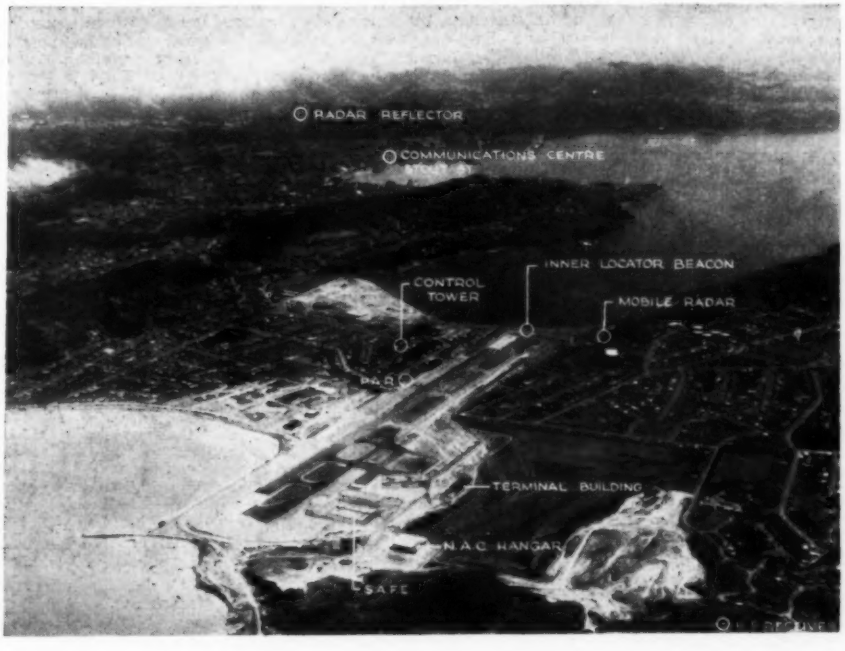
RONGOTAI OPENED

THE new Wellington Airport at Rongotai, wrested from the hills and the sea, was officially opened on October 24 by New Zealand's Governor-General, Viscount Cobham. Among the opening ceremonies was a pageant witnessed by a crowd of over 150,000 in which a Dart Herald, Voodoo, Super Sabre, Britannia, Comet, Vulcan, Viscount, Hastings, Globemaster and Super Fortress took part.

The airport is within 15 minutes' drive of the centre of the city and is the hub of New Zealand's internal air services. There has been an aerodrome on the site for many years, but it was small and ill-equipped, although it gained repute as an operational centre for R.N.Z.A.F. aircraft during World War II.

At the opening ceremony, the Prime Minister, Mr. Walter Nash, said that New Zealand offered a tremendous challenge to those whose responsibility was the construction of the Dominion's internal air transport system. Wellington Airport, by its location, its scope and its facilities, would make a material contribution to its development as the focal point of New Zealand's internal airway system.

Amenities at the New Zealand terminal should stand comparison with any other airport in the Southern Hemisphere. Aprons are broad, taxiways 60ft wide, and the total area of paved and concreted runway, taxiways, terminal and hard-standing areas (inclusive of roads and car parks) is about 80 acres.



This aerial view of Rongotai gives some impression of the engineering task that was required to "wrest it from the hills and the sea." It was opened on October 24

A LA AIR FRANCE CARAVELLE

WRITING about a flight in the Caravelle in *Flight* for August 8, 1958 (page 211), a member of the staff, discussing the relative comfort of various airliners, said: "I do not think that there can ever be any dispute about the quietness and smoothness of the Caravelle. In these two respects it sets a standard which is absolute and which I do not believe will ever be excelled."

The flight concerned was a Sud-Aviation demonstration, complete with Mozart and free champagne. It might have been possible that the author, in the light of subsequent experience, would choose less lyrical terms in which to describe Caravelle travel. But he recently flew on a normal scheduled flight to Paris, sitting in the five-abreast tourist cabin, and his impressions were, if anything, more favourable than those gained on the previous flight. A first-time Caravelle passenger sitting nearby was astonished at the glider-like silence of the aeroplane. Previously, a certain amount of cabin noise had been created by the individual passenger cold air louvres, which tended to hiss rather loudly when open. This noise has now been eliminated.

Air France have just issued a brief summary of the first three months' experience of scheduled services. They say that it has been "enthusiastically acclaimed by passengers," and "from a technical angle has given complete satisfaction in respect of punctuality, reliability and commercial operation generally." In the first three months of scheduled service, May 5 to July 31, 1959, 33,773 Air France Caravelle passengers were carried on the following routes: Paris - Rome - Athens - Istanbul; Nice - Rome; Paris - Rome; Paris - London - Nice. Since then Caravelles have been put on to the routes from Paris to Beirut, Tel Aviv, Geneva, Ankara (an extension from Istanbul), Frankfurt - Berlin and Algiers. On December 18 they are to go into service on the Paris - Cairo run, and on January 1 they will link Paris with Zurich and Munich - Vienna.

The London - Paris flight which *Flight* recently sampled was the once-daily schedule which is primarily a positioning flight for the London - Nice - London service; for the time being each pool partner on the London - Paris route operates Viscounts. From July 1 B.E.A. will introduce Vanguards.

AIR COMMERCE . . .

BOEING 707—A YEAR IN RETROSPECT

IN Nice last month Mr. Gerald M. Bowes, supervisor of operational engineering for the Boeing Airplane Company, read an account of the 707 in its first year of scheduled operation to the Twelfth Annual International Air Safety Seminar of the Flight Safety Foundation. (See report on page 559.)

In the 12 months since the first delivery was made to Pan American on August 14, 1958, said Mr. Bowes, 60 707-120s and -220s and 13 -320s and -420s had been accepted. By mid-October 73,500 Boeing 707 scheduled service hours had been flown and the aeroplanes were each accumulating time at the rate of about 250 hours per month.

The longest non-stop sector for the -120 was New York to Paris—3,150 n.m., on which about 30,000 lb of payload was carried in seven hours. At the other end of the scale the shortest sector was Los Angeles to San Francisco, only 295 n.m. On a typical non-stop transatlantic operation the aircraft was loaded to maximum cruise weight and lifted off the runway after a ground run of 7,500ft, using—in the summer—600 to 700 gallons of water for thrust augmentation. Initial cruising altitudes were 29,000ft to 33,000ft and the final cruise altitude might be 35,000ft or higher at a speed of Mach 0.8, or Mach 0.81 on long ranges.

In U.S. domestic operation, altitudes most frequently used were 27,000ft to 33,000ft and cruising speeds, depending upon fuel and payload, were up to Mach 0.83—a limit set by the thrust of the JT3C-6 engines. Experience, said Mr. Bowes, had shown that some performance and traffic control procedures made prior to the start of services were slightly optimistic. Cruise performance had been limited by temperature to a greater degree than anticipated and the opportunities to cruise at high speed rather than long-range speed had been restricted to short flight sectors. Although terminal departure and arrival times were sometimes of the order of only five to 15 minutes from gate to lift off, at other times delays of 30 minutes or longer were encountered.

On handling the 707, Mr. Bowes said that the aircraft had tremendous performance and manœuvring capabilities which provided a margin of safety when properly managed, but could expose a non-wary crew to a flight condition with which they were ill prepared to cope.

There had been three main types of flight incident which had occurred during the first year: inadvertent flight manœuvres, system problems, and incidents resulting from system or component malfunction. Take-off had long been considered critical with jet aircraft, but Boeing believed that the 707 had usable margins of tolerance. The pilot was not required to adhere rigidly to a critical speed or rotation angle, although this did not dismiss the fundamental necessity of careful take-off planning and execution, nor did it imply approval of loose and sloppy technique. Speed control was essential to safe flying of the 707.

In discussing the 707 in detail, the lecturer made reference to each of the incidents which had occurred to the Boeing 707. The most dramatic in the take-off and climb-out phase, he said, was when two engines flamed out last December as a result of leaking water injection seals. These allowed water to collect in the anti-icing system. The fault had been corrected and changes made to prevent gang activation of any control affecting engine thrust.

In the cruising phase the 30,000ft dive "of international renown" was attributed to inattention to aircraft speed and attitude accompanied by auto-pilot trip-off for an unknown reason. No subsequent changes had been made to either the auto-pilot or the aircraft.

The majority of incidents with most aeroplanes, said Mr. Bowes, were concerned with landing; but the only 707 landing that could be rightly classified as an emergency condition was the "Roman Holiday" event at Idlewild on the night of July 11. Repeated snubber failures previously experienced on the particular landing gear involved had caused successive impact loads and cracks on the truck beam. The assembly had since been modified.

In this first year there had been seven reports of nacelles contacting the runway, all but one of them on training flights. From the training accident over France last February when an engine was lost, there had been two beneficial results: an evaluation of handling and structural characteristics in unusual manœuvres and minor but worthwhile improvements to the flight control system. The loss of the American Airlines' aircraft at Long Island in August was most tragic. No final conclusion had so far been reached, except that some re-evaluation of the needs of training and the conditions under which emergencies should be simulated was required. Lest the emphasis upon these problems be misinterpreted, the lecturer cautioned, it should be positively stated that it was the consensus of pilots that the 707 was basically an easier aeroplane to fly than piston engined aircraft.

System Problems

Hydraulics System leaks and subsequent manual gear extension prior to landing had been given prominence out of all proportion to their true significance. Loss of hydraulic fluid had been responsible for the majority of unscheduled landings, but in a good many cases sufficient fluid remained to permit normal braking. The primary cause of fluid loss had been leaking shaft seals and internal failures in engine driven pumps. Action taken included improving pump reliability, employing means of relieving pump case pressure, increased filtration and improved piping installation. Spoiler system leaks were traced to easily rectified O-ring troubles.

Fore Flaps In four cases the outboard set had been lost due to structural failure; there was no adverse effect on lateral control and completely re-designed fore flaps had corrected the problem.

Electrics Malfunctions had principally concerned constant speed drive units, generator control panels and voltage regulators.

Flight Controls These had proved very reliable and satisfactory. There had been three incidences of a sticking trim, believed to have been caused by frozen moisture on the trim-screw actuator. A shield had been added and the lubrication revised. Minor modifications had been made to the elevator and rudder to improve their feel.

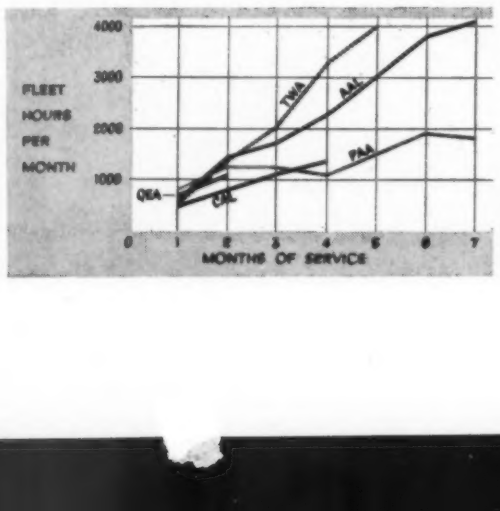
Landing Gear Apart from the snubber failures and a single truck beam failure, the only significant problem had been galling of the truck beam/oleo leg pivot bolt. Troubles with nosewheel shimmy had been solved.

Powerplant Engine failure rate was currently one per 5,000 hours and the engine time per in-flight shut down averaged 12,000 hours. Maintenance of thrust reversers and sound suppressor tubes needed to be reduced but the chief trouble had been with water injection; principally the unsatisfactory life of the engine-driven water pump and submerged electrically driven pump. An active test programme was expected to resolve the troubles.

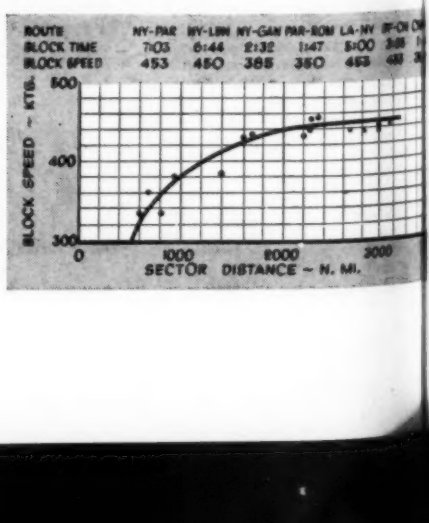
Fuel System Early fuel contents and flow indicators were not satisfactory. The quantity problem had been solved and fuel-flow indicators were being vigorously investigated.

Air Conditioning Difficulties with the freon air conditioning system had been numerous and complex. They included cabin temperature instability, pack trip-offs and unsatisfactory ground cooling. Modification programmes were under way.

In conclusion, Mr. Bowes said that the first year reflected the undisputed success which had accompanied the introduction of the 707. Post delivery system experience had been "definitely conventional in nature" and that trend of difficulties was decreasing. There was a much greater understanding by Boeing of day-to-day operation. The pilots liked the 707 and the thrill of flying it had brought back to senior pilots the gleam in their eyes.



(Left) Initial utilization by PanAm, American, T.W.A., Continental and Qantas



(Right) Achieved 707 block speeds. LDN, London; NY, New York; PAR, Paris, ROM, Rome, LA, Los Angeles; SF, San Francisco; CHI, Chicago

On course at Vickers' Aircraft Servicing School at Weybridge are the first of B.E.A.'s maintenance staff to undergo training on the Vanguard. They are studying a tinted reproduction of a "Flight" cutaway drawing

FRIENDSHIP ORDER-BOOK

THE Friendship order-books of Fokker and Fairchild are now, respectively, about 50 per cent complete and about 75 per cent complete. Of 51 aircraft on the Fokker books 26 have been delivered; of 72 on the Fairchild books only 18 have still to be delivered. Here, for the record, is the present production and delivery situation:—

Fokker-built: *Aer Lingus*, 7 (RDa.6), delivery complete; *Ansett-A.N.A.* (including *Butler Air Transport* and *Queensland Airlines*) 6 (RDa.6), current delivery; *Braathens S.A.F.E.*, 2 (RDa.6), delivery complete; *East-West Airlines* (Australia), 1 (RDa.6), delivery complete; *Helmut Horten G.m.b.H.*, 1 (RDa.7), delivery November 1959; *Iran, H.I.M. The Shah*, 1 (RDa.6), delivery complete; *Iranian Oil*, 2 (RDa.6), delivery December 1959; *K.L.M.*, 2 (RDa.6), delivery April, 1960; *Mac.Robertson Miller Airlines*, 1 (RDa.7), delivery November 1959; *Netherlands Department of Civil Aviation*, 1 (RDa.6), delivery March 1960; *Philippine Air Force*, 1 (RDa.7), delivery complete; *Philippine Air Lines*, 2 (RDa.6), delivery February 1960; *Royal Netherlands Air Force*, 12 (RDa.6), delivery 1960; *Trans-Australia Airlines*, 7 (RDa.6), delivery complete; *Australian Department of Civil Aviation*, 2 (RDa.6), delivery complete.

Fairchild built: *Aerovias Ecuatorianas*, 1 (RDa.7), delivery complete; *Aerovias Venezolanas*, 5 (RDa.6), delivery complete; *Aloha Airlines*, 3 (RDa.6), delivery complete (an order for an additional 3 is not yet confirmed by Fairchild); *Banco de Mexico*, 1 (RDa.7), delivery complete; *Bonanza Air Lines*, 10 (RDa.7), current delivery; *Butler Aviation*, 1 (RDa.7), delivery complete; *Champion Spark Plug Co.*, 1 (RDa.7) delivery complete; *Continental Can Corp.*, 1 (RDa.7), delivery complete; *General Tire and Rubber Co.*, 1 (RDa.6), delivery complete; *Ideal Cement Co.*, 1 (RDa.7), delivery complete; *Johns-Manville Corp.*, 1 (RDa.6), delivery complete; *Kimberly-Clark Corp.*, 1 (RDa.7), delivery complete; *Noland Co.*, 1 (RDa.6), delivery complete; *Northern Consolidated Airlines*, 3 (RDa.6), delivery complete; *Olin Mathieson*, 1 (RDa.7), current delivery; *Ozark Air Lines*, 3 (RDa.6), delivery complete; *Pacific Airlines*, 6 (RDa.7), delivery complete; *Piedmont Airlines*, 8 (RDa.6), delivery complete; *Quebecair*, 3 (RDa.6), current delivery; *Raytheon*, 1 (RDa.7), delivery complete; *Reynolds Metal Co.*, 1 (RDa.7), delivery complete; *Reynolds Tobacco Co.*, 1 (RDa.6), delivery complete; *Trans Mar de Cortes*, 1 (RDa.6), delivery complete; *U.S. Steel*, 1 (RDa.7), current delivery; *West Coast Airlines*, 6 (RDa.6), delivery complete; *Westinghouse Electric Corp.*, 1 (RDa.7), delivery complete; *Whitney*, 1 (RDa.7), delivery complete; *Wien Alaska Airlines*, 2 (RDa.7), delivery complete; Undisclosed customers, 5.

BREVITIES

In Brussels on November 2, the creation of Air Union by Air France, Alitalia, Sabena and Lufthansa was given the approval of the civil aviation ministers of the countries concerned, who promised "all necessary support."

Slick has given Canadair a letter of intent for two CL-44s with an option on an additional four.

A new K.L.M. Viscount service, at a frequency of two flights daily, was opened between London and Rotterdam on November 2.

K.L.M. are another airline that reports a successful third quarter of the year. In this case operating revenues cancelled out an overall loss incurred during the first six months of 1959.

Further talks between the U.S. State Department and the Dutch Government on rights for K.L.M. to serve the U.S. West Coast are to start in Washington on December 8.

A memorial service to W/C. A. D. ("Bats") Page, whose death occurred on November 3, will be held on November 19 at Christ Church, Down Street, London, W.1, at 11.30 a.m. W/C. Page was aircraft sales manager of Airwork.

The Dutch Government have ordered 18 Saab Safir 91Ds for training K.L.M. pilots. Five have already been delivered to the Dutch Government Flying School at Eelde, where they will replace a number of other aircraft including Safir 91As.

Shell Aircraft, who are based at Blackbushe pending a move to another airport, are not connected with Morton—as a paragraph on page 478 of *Flight* for October 30 may have suggested—nor are they associated with the Blackbushe Airport Tenants' Association formed to fight the closure of the airport.

A B.O.A.C. Comet proving flight left London for Johannesburg on November 3. There were to be demonstrations in Johannesburg on November 5, Durban and Port Elizabeth on November 6 and Cape Town on November 7. A second proving flight will leave today, November 13. Passenger services to South Africa start on December 2.

Mr. David Proudlove, formerly Civil Air Attaché in Washington and subsequently president of the Bristol Aeroplane Company in the U.S., has been appointed a vice president of Aircar Engineering International Inc. This is a new company formed by Air Carrier Service Corporation and its parent company, Californian Eastern Aviation, "more adequately to meet the needs of aviation underwriters and financial interests."

The Boeing 707 "Dash Eighty" prototype is being adapted to make use of boundary layer control.

Sabena has been granted a credit of £7,142,000 by the Ex-Im bank for the purchase of its five Boeing 707s.

An Air Corporations bill, read in Parliament on October 29 and on November 5, would increase B.O.A.C.'s borrowing powers to £180m and B.E.A.'s to £95m. This is an increase of respectively £20m and £35m.

The new president of Aerolineas Argentinas is Brigadier (R) Miguel Moragues. He was previously C-in-C. Argentine Air Force until September 1958.

A DC-3 of Piedmont Airlines crashed near Waynesboro, Virginia, on October 30. Of the 27 people on board, there was only one survivor, who was not found until November 1. He was still strapped into his seat.

A new windscreen of 70 per cent greater area has been developed by Canadair for the swing-tail CL-44 (early CL-44s have a Britannia-type windscreen). Panels in the new screen are larger, fewer in number and extend rearwards, and the roof panels have been deleted.

Austrian Airlines (A.U.A.) may receive a state credit of £2m to purchase four Viscounts. The present fleet of four Viscounts is rented from Fred Olsen (who hold a 15 per cent shareholding) and as from next summer A.U.A. say that they do not intend to rent more than two and new aircraft are to be bought to bring the total to six.

Sir Patrick Dollan, chairman of the Scottish Advisory Council for Civil Aviation, said in Glasgow last week that Comets are to be introduced on London-Glasgow and London-Edinburgh routes in about two years' time. B.E.A. say that they have no immediate plans for using Comets on domestic services. Weekend flights to Scotland have been reduced to £8 return for the winter season.

S.A.S. have ordered two Convair Intercontinental 600s—the airline's name for which is Coronado—for service in 1961. These are in addition to the two which are to be leased from Swissair. The 600s will probably be used on the airline's routes to South America, Africa and the Far East via India.

Frederick B. Ayer and Associates have prepared a new sales brochure outlining a new leasing programme for Convair 240s. It includes a provision whereby selected interior and aircraft modifications can be paid for at the rate of $10,000 a month while the aircraft is on hire without an obligation to continue the lease once the cost of conversion has been paid off.

First helicopters to be ordered specially for the Queen's Flight, these Westland Whirlwind HCC Mk 8s were formally handed over to the flight's commanding officer, W/C. R. G. Wakeford, at Yeovil on November 5 by Mr. E. C. Wheeldon, Westland managing director. Our reference to the seating layouts in last week's description should have read "2, 1 and 3" for the diagrams and "1, 3 and 4" for the photographs in the final caption on p. 497

SERVICE AVIATION

Royal Air Forces and Naval Flying News

Goodwill Mission

TWO Canberras of Flying Training Command left Little Rissington last Monday on a goodwill visit being undertaken by the C.F.S. Commandant, A. Cdre. J. N. H. Whitworth, to overseas air forces whose officers have been trained at the Central Flying School. A. Cdre. Whitworth was flying as co-pilot in one of the Canberras, which were being captained by W/C. P. W. Gilpin and F/L. R. F. Tracy. The tour itinerary includes visits to the R.A.A.F. and R.N.Z.A.F. and also to the Royal Thai, Burmese and Pakistan Air Forces. The round trip, lasting 31 days, will cover more than 27,000 miles.

Coastal Command Future

A FIRM decision has been reached on the future of Coastal Command: it is to continue as a separate R.A.F. command, the shore-based maritime air forces forming part of the Royal Air Force. In maritime operations or exercises the senior Naval commander in each area, at home or overseas, will decide the operational task on which shore-based maritime aircraft are to be employed and give the necessary orders to the senior maritime air force commander in the area concerned.

These decisions were conveyed by the new Minister of Defence, Mr. Harold Watkinson, in a Parliamentary answer last week. He said that they had been reached "after a full review of the present arrangements."

Taranto Remembered

PARTICIPANTS in the Taranto Raid on November 11, 1940, met again for a commemorative dinner at R.N.A.S. Lee-on-Solent last Friday. A Swordfish standing in front of the wardroom was floodlit as a reminder of the 20 "Stringbags" which took part in the attack on the Italian fleet, an action described by historians as "an example of the economy of force, the success of which had a profound effect on the Mediterranean situation." Only two of the 40 pilots and observers who took part were lost, and the attack—pressed home after a flight of 170 miles from *Illustrious*—left three of the most powerful Italian Navy units crippled and others sinking. Over 150 officers attended the dinner at Lee-on-Solent, including Admiral Sir Denis Boyd, who commanded *Illustrious* at the time of the raid.

A dramatic view of the Vulcan of No. 617 Sqn. during the landing at Rongotai Airport, Wellington (see air view on p. 561), when it damaged the port oleo and ruptured a fuel tank. Later the pilot, S/L. A. A. Smailes, made a successful emergency landing at R.N.Z.A.F. Ohakea (as recorded on this page, October 30)

New R.Aux.A.F. Units

THREE new R.Aux.A.F. units, to be known as Maritime Headquarters Units, are being formed. They will provide backing for the R.A.F. component at the joint Naval/Air Maritime H.Q.s at Northwood, Pitreavie and Plymouth and each be associated with one of them.

The Secretary of State for Air, Mr. George Ward, gave this news in a written reply to a Parliamentary question last week about the future of No. 3603 (City of Edinburgh) F.C.U. He said it was no longer required in its present rôle and would be formally disbanded; but he hoped many of its members would transfer to No. 2 M.H.Q. unit (at Pitreavie).

Mr. Ward added that the new units would be controlled by Coastal Command, their main tasks being communications between headquarters in this country and in other NATO countries, controlling maritime aircraft and looking after communications equipment.

There are vacancies for officers, airmen and airwomen in all three units and further information may be obtained from Commanding Officers at the following addresses:—No. 1 Maritime Headquarters Unit (R.Aux.A.F.), c/o. H.Q. Coastal Command, R.A.F. Northwood, Middx; No. 2 (City of Edinburgh) Maritime Headquarters Unit (R.Aux.A.F.), 25 Learmonth Terrace, Edinburgh; No. 3 (County of Devon) Maritime Headquarters Unit (R.Aux.A.F.), c/o. H.Q. No. 19 Group, R.A.F. Mountbatten, Plymouth, Devon.

A.V-M. H. G. Ambler (centre), who handed over the squadron standard to the former No. 608 (North Riding) Sqn., R.Aux.A.F., at R.A.F. Middleton St. George on November 1, with G/C. A. V. R. Johnstone, station commander (left), and G/C. G. Shaw, president of the No. 608 Sqn. Association

HAS.7s Return

WHIRLWIND HAS.7s are now back in service with the Fleet Air Arm, their engine and transmission systems successfully modified, after being withdrawn seven months ago. Admiralty stated recently that No. 815 Sqn. is in commission with a full complement of aircraft and that other squadrons are re-forming.

IN BRIEF

A new A.T.C. squadron, No. 2348, has been formed at Maghull, Liverpool. The C.O.-elect is Mr. H. D. Dormer.

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The aircraft carrier *Hermes* is to be accepted by the Royal Navy from her builders, Vickers-Armstrongs Ltd., at sea in the English Channel next Wednesday (November 18).

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Canberras of Nos. 6 and 73 Sqns., based in Cyprus, participated last week in a three-day air defence exercise over West Pakistan organized by the Central Treaty Organization.

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S/L. K. A. C. Wirdnam, a staff officer at Flying Training Command headquarters, is going to the Antarctic as an observer with the United States expedition "Deep Freeze V."

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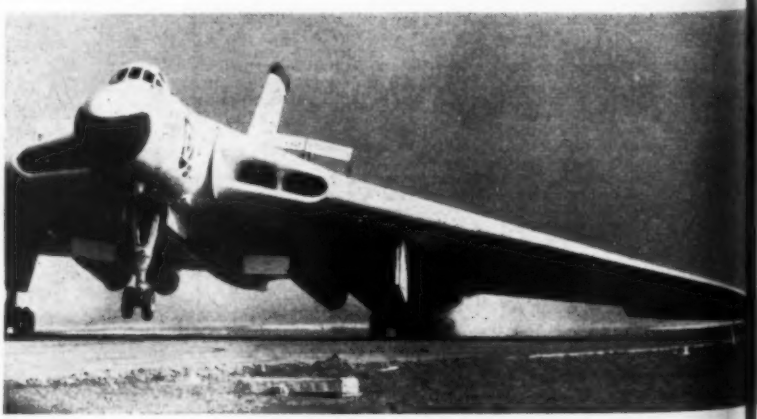
The ten D.H. Comet 2s in service with R.A.F. Transport Command have just completed 10m miles flying, an average of a million miles each and the equivalent of some 420 flights round the world.



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